Compliance Rates in Overweight Subjects Following Low Sucrose and Sucrose Containing Diets

Thesis

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COMPLIANCE RATES IN OVERWEIGHT SUBJECTS FOLLOWING LOW SUCROSE AND SUCROSE CONTAINING DIETS.

A Thesis in Fulfilment of the Requirements for the Degree of Master of Philosophy of the Open University.

Dietetics and Nutrition.

by

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To my parents for their continual encouragement and support.

COMPLIANCE RATES IN OVERWEIGHT SUBJECTS FOLLOWING LOW SUCROSE AND SUCROSE CONTAINING DIETS.

Abstract for the Degree of Master of Philosophy for the Open University

by Janet West.

Clinical obesity in the U.K. today is escalating despite continual attempts to reduce it (Prentice and Jebb, 1995). Compliance is central to successful weight loss and is influenced by many factors including dietary composition. It is postulated that deviations from reducing diets may be due to the exclusion of popular foods such as those containing added sucrose. Traditionally this type of sugar has been excluded from weight reducing diets and blamed as a significant contributor to obesity. However, evidence to justify the removal of it is sparse. Westenhoefer et al, (1993) suggest that the avoidance of sucrose offers no advantages in weight-reducing diets, yet it is still routinely excluded in dietetic practice. The present study compares the rates of weight loss of overweight individuals on two energy reduced diets in which the amounts of commercially added sucrose are varied.

Compliance may also be affected by behavioural factors. Attitudes and beliefs about different foods are important determinants as to whether a particular food is consumed (Shepherd, 1989) and therefore, whether prescribed diets are adhered to.

The present crossover study evaluated compliance rates, weight loss and dietary beliefs of subjects on two isoenergetic energy reduced diets containing quantifiable differences in added sucrose. Sixty-eight subjects were randomly allocated to either a Low Sucrose Diet (LSD, providing no more than 5% energy from added sucrose) or a Sucrose Containing Diet (SCD, providing 10% energy from added sucrose) for eight weeks and then switched to the alternate diet for 8 weeks. A questionnaire to explore attitudes and beliefs towards the diet was completed at weeks 0, 8 and 16. Weight was measured every fortnight and food record diaries were completed at baseline and weeks 2, 4 and 8 of each diet.

Weight loss at eight weeks was 2.2kg (LSD) and 3.0kg (SCD). During weeks 9-16 minimal weight loss occurred. Interpretation of nutrient data after 'switch over' was not possible due to under-reporting. Added sucrose levels at week 8 were 5% (LSD) and 9.0% (SCD) energy. Fat was lower on the SCD than on the LSD at this time. Both groups had positive attitudes towards reducing sucrose in their diets.

In conclusion, weight loss can occur on a weight reducing diet which contains added sucrose. However pre-existing negative attitudes towards the inclusion of added sucrose and foods containing it could create barriers to compliance using this approach.

*All references to **'added sucrose'** refer to commercially added sucrose (non-milk extrinsic sugars).*

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1.0 CHAPTER ONE

Introduction

1.1. *Difficulty in treating obesity*

Clinical obesity in Britain has doubled over the past decade (Prentice and Jebb, 1995). It has been linked with increased morbidity and mortality rates, and is a common contributing factor to several mechanical, cardiovascular and metabolic complications (Galtier-Dereure et al, 1995). A quarter of all adults in the U.K. are thought to be on diets at any one time (Kent and Bowyer, 1992). Theoretically obesity is easier to correct than most other diseases (Garrow, 1981), yet inspite of this, weight loss and weight maintenance programmes are still largely unsuccessful (Pacey et al, 1987). Trends are not improving, but seem to be on the increase as reported in 'The Plate of the Nation' (Cooperative, 1995). A report undertaken by the Department of Health (1995) suggests that based on current trends the prevalence of obesity by the year 2005 would be around 18% of men and 24% of women. Such figures are almost triple those of 1980. Since obesity is one of the most important preventable causes of ill health in the U.K. today (Kent and Bowyer, 1992) such speculation is the cause of great concern. These messages hardly instil hope in those who are struggling to lose weight in a climate where overweight and obesity are stigmatised, and efforts to reach 'Health of the Nation' (1992) targets for the year 2000 seem rather naive.

Even if weight loss does occur, 80-90% of individuals regain all or some of the lost weight (Alpers et al, 1995), many reverting back to their old eating habits. Research has shown that the treatment of clients with simple obesity is an inefficient and ineffective use of the dietitian's time (Podduch, 1988). Unrealistic goals result in frustration and poor compliance. Since therapists, and patients do not often recognise the chronic nature of obesity, many still believe in a 'cure'. Rossner (1995) suggests as in other chronic illnesses, this 'cure' is unlikely. However, if targets are realistic, patients may have more of a chance (Rossner, 1995). Research suggests that the treatment of obesity would seem to be a question of life long therapy (Pudel and Westenhoefer, 1992).

1.2 *Compliance, weight loss and dietary adherence*

Compliance is a key factor to success. It is defined, according to Stedman's Pocket Medical Dictionary (1993), as the degree of adherence by a patient to a prescribed regimen. The problem of non-compliance is big and costly for both the individual involved and the health care system (Ley, 1989). Nutritional and pharmaceutical strategies are legion, but, such interventions have had little more success than Stunkard reported in 1959.

Compliance is influenced by many variables, including knowledge about the diet (Cole-Hamilton et al, 1986, Warwick and Williams, 1987, and Bradley and Theobald, 1988); and understanding the information given (Ley 1986). Printed material may improve the effectiveness of therapy, but this is not always the case (McQueen and Frost, 1995). Leaflets must be intelligable (Cole, 1979). Motivation is another important factor in compliance (Gallagher and Allred, 1992) as long as individuals know what is expected of them.

Several other factors have been identified as influencing the successful outcome of weight reduction. These include age (Leelarthaepin and Steinbeck, 1980), initial weight (Leelarthaepin and Steinbeck, 1980, Pavel et al, 1968), sex (Stunkard and McClaren-Hulme, 1959, Craddock, 1977), onset of obesity (Craddock, 1977, Cooper et al, 1979), family history (Douglas et al, 1981), marital status (Craddock, 1977, Stein et al, 1981) occupation and activity (Leelarthaepin and Steinbeck et al, 1980), type of referral (Stein et al, 1981) and medical history (Craddock, 1977 and Seaton Rose, 1965). Dietary composition also has significant influence over compliance (see section 1.1.3).

1.2.1 Indicators of Compliance.

This study used fortnightly **weight measurements (kg)** and reported **nutrient and added sucrose* intakes,** as indicators of compliance. Predicted weight loss was calculated to measure successful weight loss.

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* *The term 'added sucrose' used through out the thesis refers to commercially added extrinsic sucrose.*

1.2.2 Measuring Compliance Using Dietary Adherence.

Nutrient intake can be a measure of compliance. Estimated food record diaries will be used to measure dietary intake in this study. Many errors can occur in dietary assessment, and great care must be taken to minimise these. Before deciding to use a particular method of measuring dietary intake, research should be carried out to look at the pros and cons of each methodology and consider their suitability.

1.2.3 Errors in Measurement

Although it is generally assumed that weighed food records are the most accurate dietary assessment method to use for free living individuals (Marr, 1971), they have their drawbacks. Livingstone et al (1990) reported suspiciously low energy intakes in 7 day weighed dietary records (as compared with Doubly Labelled Water Technique). Prentice et al (1986) found similar results. Thus, although weighed intakes have been seen to be the most accurate, they are not the most valid, method of dietary assessment.

In view of the many other requests to be placed on the subjects, weighed food records will not be used. A list of estimated food portions which are more likely to reflect normal dietary patterns, which could be clarified by interview, were considered to be more valuable than running the risk of unreported, unweighed foods.

Many researchers look on the use of estimated food records favourably. Edington et al (1989) compared estimated records with weighed intakes for individuals some 3-7 months apart. There would have been some variation due to weekly and seasonal variation. In view of this, correlation for total energy (0.74), protein (0.70), fat (0.80) and carbohydrate (0.84) was remarkably good. Todd et al (1983) found no difference in the mean protein and energy intake by weighing compared to food diary. Hackett et al (1983) used interviews after diary recordings (as were used in this study) to improve reliability. They suggested that diary and

interview recorded more qualitative information than the food diary alone. This method is good at singling out the consumption of snacks, sweets and beverages which may be easily omitted from the diaries (Pearce et al, 1981). Several other studies in adults have found good agreement between estimated and weighed records. Cade (1988) suggested that differences between the two measures were less than 10% for most of the nutrients. Nelson and Nettleton (1980) also found good agreement between these two methods and Ralph et al (1990) suggest that estimated records were a simple but relatively accurate method of estimation of energy and macronutrients in groups of people.

As the estimation of food portion sizes is the largest source of error in estimated food records, Bingham (1988), particular attention will be paid to determining and checking weights at the fortnightly interview. If possible individuals will weigh some foods. The length of time over which food record diaries should be kept is a further point of discussion. The length of time should allow for fluctuations in habitual food intake, in that when results are averaged out, an accurate picture of average food intake is obtained. Some researchers believe that one week is as representative as any other week (Werlock 1987 and Nelson 1983).

Cameron and van Staveron, (1988), cite Bingham et al, who suggest that for groups, there is little statistical justification in extending numbers of records beyond three days. Doyle et al (1989) suggested that if dietary records can be satisfactorily collected over a period of less than 7 days the level of compliance should increase.

Since food intake records substantially under-report the habitual energy intake of obese subjects (Jebb and Prentice, 1995) during dieting and non-dieting periods, data available on dietary assessment for the general healthy population, may not be appropriate. As yet, there appear to be no specific guidelines on methods used to quantify dietary intake in the obese.

1.2.4 *Compliance and Dietary Composition..*

Traditionally, added sucrose has been excluded as a forbidden food and a significant contributor to obesity. However, there seems to be little work to support this concept. The COMA report, (1989), 'Dietary Sugars and Human Diseases', could not find sufficient evidence to support this tenuous link.

Westenhoefer (1994) argues that weight reducing diets which are too rigid promote poor compliance compared to diets which allow more flexible food consumption. This suggests that a more varied intake may have a positive effect on compliance. Craving sweet things often occurs after the denial of sugar containing foods, often resulting in bingeing (Tuschl, 1990), whereas, flexible self control helps to decrease the tendency to become obese. It is to be presumed that the problems in the eating habits of the obese are induced not least by the reduction measures which persons who are overweight undertake either on their own initiative or on the advice of their doctor. Further investigations into the nutrient constituents and the limitations of therapeutic diets and how these effect dietary adherence, are therefore, merited.

It is postulated that deviations from weight reducing diets may be due to the exclusion or severe reduction in popular foods such as those containing added sucrose. This has often been blamed by consumers as fattening (Gibney, 1995) and as such, weight loss strategies still advise on low added sucrose regimes. However, studies have shown that higher intakes of sucrose are not associated with obesity, unlike dietary fat consumption (Bolton-Smith and Woodward, 1994 and Hill and Prentice, 1995). Bolton-Smith and Woodward, (1996) argue that diets rich in carbohydrate, whether complex or simple sugars, may assist in weight loss providing that fat intake is reduced. McCreery (1991), found that the frequent exclusion of foods containing added sucrose, from weight reducing diets had a significant, negative influence on compliance rates. Anderson (1995) suggests that sugar consumption as well as

carbohydrate consumption are associated with leanness not obesity. In addition to energy intake it is believed that the macronutrient profile of the diet, plays an important role in long term energy imbalance. Raben and Astrup, (1996) suggest that carbohydrate rich diets composed of starch or simple sugars, may help obesity prone individuals achieve and maintain macronutrient balance and body weight in the long term.

Inspite of this evidence, the routine practice of reducing or excluding added sucrose from the diet appears to persist. Practices which advocate the removal of foods containing added sucrose from weight reducing regimes, therefore, appear to be unjustified.

1.2.5 *Weight Loss and Compliance.*

Successful strategies for weight loss should ensure that energy intake is less than energy expenditure so that a temporary negative energy balance is created, and fat stores are metabolised. Treatments for the overweight and obese are legion, ranging from the conventional to the less conventional and even hazardous. The main aim is to reduce body fat rather than lean tissue. A weight loss of 0.5-1kg (1-2lbs) per week, should be aimed for (Garrow, 1991). Garrow (1991) suggests that weight loss greater than 1kg/week could be at the expense of lean tissue. This may cause undesirable adaptations in metabolic rate so that weight maintenance often becomes difficult when the diet ends. Weight reducing diets need to be well balanced including good supplies of vitamins and minerals to prevent any nutritional deficiencies. Equally it is important to ensure that the diet re-educates the patient to adopt healthier eating practices so that weight loss will be maintained after the desired weight loss is achieved.

1.3 Role of Carbohydrate, Added Sucrose and Fat in the Aetiology and Maintenance of Obesity

Research indicates that the removal of added sucrose from diets may cause an increase in fat intake as a compensatory measure (Black, 1991, and Gibney, 1995). The removal of added

sucrose and foods containing it from weight reducing diets has similar potential (Bolton-Smith and Woodward, 1994). Fat is more energy dense (McCance and Widdowson, 1992) and less satiating (Lawton, et al 1992 and Blundell and Green, 1996) than carbohydrate and as such is less desirable in weight reducing diets. Low fat, high carbohydrate diets can result in significant weight loss and may be important because they have an increased effect on satiety (Blundell and Green, 1996).

It has been suggested that sugar alone may be the important variable in enhancing carbohydrate consumption (Bolton-Smith and Woodward, 1995). Added sucrose is less bulky than starch and by incorporating it in the diet carbohydrate is easily increased (Bolton-Smith and Woodward, 1994). However, some studies contest this, implying that extrinsic sugar may sometimes be a vehicle for dietary fat. Emmett and Heaton (1995), found that an increase in extrinsic sugar was associated with a linear increase in the intake of sweetened fat products such as cakes and biscuits. This may be the case for fat/sugar combination foods, but perhaps not for diets based on items high in added sucrose and low in fat.

The benefits of a high carbohydrate, low fat diet are apparent in the literature. The capacity of the body to convert carbohydrate into fat is much less efficient than it is converting dietary fat into adipose tissue. High fat diets are, thus, seen to promote fat accumulation more than high carbohydrate diets (Horton et al, 1995). Carbohydrate ingestion promotes carbohydrate oxidation, whereas, the ingestion of fat does not promote fat oxidation and excess is stored as body fat. This is perhaps why many studies report on the success of low fat ad libitum carbohydrate diets (Prewit et al, 1991 and Shah et al, 1994) and provides further justification for including both complex and less bulky forms of carbohydrate (added sucrose) in weight reducing regimes.

Basal Metabolic Rate (B.M.R.) often drops in those following weight reducing regimens, making weight maintenance problematic once the diet is over. Some workers suggest that

weight reducing diets that are high in carbohydrate may be able to maintain basal metabolic rate, (Lyon et al, 1995 and Hendler and Bonde, 1990). However, these studies should be viewed with caution since the amount of carbohydrate consumed was much higher than would be normally consumed in 'every day' diets and, as such, associations with B.M.R and increased carbohydrate warrant further research.

The present study investigates whether the omission of foods containing added sucrose, a traditional feature of weight reducing diets, is a factor in compliance, which might affect weight loss.

1.3.1 Sugar - a Nutrient Diluent?

Added sucrose has been questioned about its potential for lowering the quality of the diet (Department of Health, 1989) and of being a nutrient diluent, providing 'empty' calories. The COMA report (1989), 'Dietary Sugars and Human Diseases', suggested that micronutrient density was lowest in those selected for the highest proportional contribution of non-milk extrinsic sugars (providing 21% energy for males and 19% energy for females), particularly for those individuals who have low energy intakes. Heaton et al (1983) in a study which allowed subjects to eat unrestricted amounts of refined foods, (including confectionery and added sucrose in drinks), suggest that the consumption of refined foods caused a reduction in nearly all the vitamins and minerals listed in the standard food tables. Bolton-Smith and Woodward (1995) suggest that the prevalence of anti-oxidant vitamin adequacy is significantly related to dietary sugar intake, in that both low and high extremes of extrinsic sugar consumption are associated with poor anti-oxidant vitamin intake. However, they suggest that practical recommendations for health should still be for a varied diet which can safely contain extrinsic as well as intrinsic milk sugars.

However, Naismith et al (1995), examining the eating patterns of children, suggest that high intakes of non-milk extrinsic sugar in their diets does not compromise micronutrients.

Bolton-Smith and Woodward (1996), also suggest that for general populations with a sufficient energy intake nutrient adequacy can be achieved across a wide range of dietary sugar intake (providing 4-20%, energy). Similarly, Nelson (1991) argues from his study on school children, that micronutrient intakes do not differ significantly between the top (providing 28% energy for boys and 27% energy for girls) and bottom (providing 16% energy for both girls and boys) levels of sugar intake. Gibson (1992) similarly argues that micronutrient intakes do not significantly differ between top and bottom ranges of sugar intake.

There seems to be little research reporting the effects of added sucrose on micronutrient status, in those following weight reducing diets. Therefore, this study aims to observe trends in vitamin and mineral status, to readdress the 'empty' calorie theory associated with such diets.

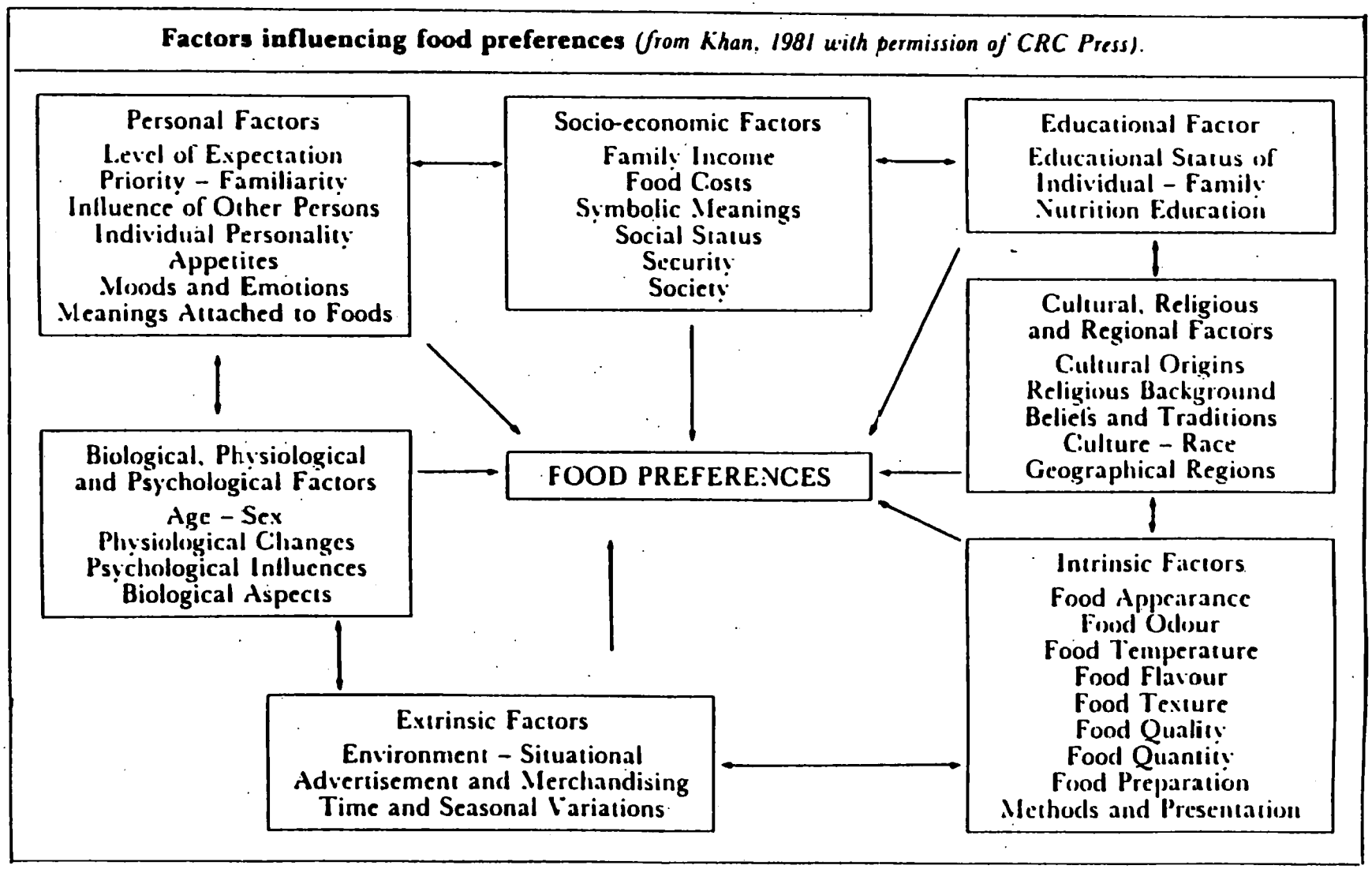
1.4. Obesity Behavioural Aspects and Social Implications.

1.4.1 Behavioural Aspects.

Obesity is a multifactorial condition which results from an interaction between genetic predisposition and many environmental variables, including diet (Drewnowski, 1991). Food choice (which may contribute to obesity and also weight loss) is affected by many influences, which in the light of a plentiful and varied food supply need due consideration. Khan (1981) as cited by Shepherd, (1990) illustrates the main factors affecting food preference, (Fig. 1.). In order to arrive at an overall understanding of the reasons for food choice, especially in relation to obesity and weight reduction, it is necessary to adopt an interdisciplinary approach, taking into account the inputs from these various sources (Shepherd, 1990).

Attitudes and beliefs may influence food choice (Shepherd, 1989) and ultimately compliance. Gibney (1995) has shown that consumers consider carbohydrate and sugar (added sucrose) to be "fattening," in a similar way that Thomas (1981) found that starchy foods may be

Fig 1. (cited by Shepherd, 1990).



avoided because of beliefs that they promote obesity. In 1972 Yudkin stated that sugar was "pure, white and deadly". It is little wonder, therefore, that individuals may formulate opinions that added sucrose is a 'forbidden food', when trying to lose weight. Attitudes and beliefs about different foods, may be very powerful in determining whether or not that particular food is consumed (Shepherd, 1989). This may have considerable impact on whether prescribed diets are adhered to, which is extremely relevant to this study. Clinically the main treatment for obesity focuses on dietary intervention, which is largely ineffectual (Pacey et al, 1987. The advantages of an approach to weight reduction and compliance which considers the behavioural aspects of food choice, therefore, seems to be an appropriate strategy, and has been used before (Vigus et al, 1995). Although taste has frequently been suggested as having the most influence over food preference (Krondl and Lau, 1982), the nutritional/health beliefs of an individual may also be important (Medeiros, et al 1996, and Shepherd, 1988). If an overweight subject believes that added sucrose and foods containing it promote and maintain obesity, then they are unlikely to be enthusiastic about incorporating them in their diet. However, whether these beliefs dictate subsequent behaviour requires exploration, since another individual with the same knowledge and beliefs may still opt to eat them, as taste sometimes over rides nutritional beliefs (Krondl and Lau, 1982). Health benefits are not always strongly correlated with food choice (Shepherd and Stockley, 1985, Cotugna et al, 1992). It is, therefore, important to understand the attitudes and beliefs which relate to the behaviour of eating certain foods and how these vary within populations if any impact is to be made in implementing dietary guidelines (Shepherd and Stockley, 1985).

There are a number of standardised and validated psychological tools which have been developed to measure attitudes and beliefs, such as the Theory of Planned Behaviour, (Ajzen, 1988), an extension of the Theory of Reasoned Action (Ajzen and Fishbein, 1980), which enables the prediction and understanding of human behaviour.

The Theory of Planned Behaviour (Ajzen, 1988) incorporates measures of attitudes and beliefs and relates them to outcome behaviour. Both of these models have been used in many studies to predict factors affecting food selection (see Table, 1). However, studies which use these models to predict dieting behaviour and weight loss (seen in Table, 1) are sparse and more research in this area seemed warranted.

1.4.2 The Theory of Reasoned Action

According to the TRA, (Ajzen and Fishbein, 1980) the immediate antecedant of any behaviour is **intention** to perform the behaviour in question. The stronger the person's intention, the more likely they are expected to try and hence the greater the likelihood that they will actually carry out the behaviour.

The model specifies that there are two main antecedents of **intention**, which are **attitude towards the behaviour** (whether favourable or unfavourable), and **subjective norm**, or the perceived social pressure (from salient others) to perform or not perform the behaviour.

The TRA also deals with the antecedents of attitudes and subjective norms. These will only be explained briefly to make up the whole picture. Attitudes are thought to be determined by beliefs about the likely consequences of performance, weighted by an evaluation of these consequences (**belief about outcome x evaluation of outcome**). Subjective norm is derived from perceptions of the expectations of important others, weighted by motivation to comply with their wishes (**normative beliefs x motivation to comply**) (Conner, 1993).

The TRA requires that the behaviour under consideration be under volitional control (Ajzen and Fishbein, 1980). A behaviour is said to completely under a person's control if the person can decide at will to perform it or not to perform it. Most intended behaviours, however, are goals whose attainment is subject to some degree of uncertainty (Ajzen and Madden, 1985). Therefore, the TRA, which relies on intention as the sole predictor of behaviour, was seen to

be insufficient whenever control over the behavioural goal was incomplete. The TPB was, thus, proposed in an attempt to go beyond purely volitional action (Ajzen, 1988, Schifter and Ajzen, 1985).

1.4.3. The Theory of Planned Behaviour

Predictions of non-volitional behaviour have been added recently to the TRA, to provide the TPB. A third component is added which is the amount of control the individual perceives over the behaviour in question. Ajzen (1991) suggests that this will predict behavioural intention, and where the person is correct in perceiving control over the behaviour, it will also predict the behaviour (Conner, 1993). **Perceived control** is measured as judgements of the extent to which factors facilitate or inhibit the behaviour, multiplied by their frequency of occurrence.

1.4.4. *Limitations of the T.R.A. and T.P.B.*

Although it is important to recognise that Fishbein and Ajzen (1980) and Ajzen (1988) formulated a coherent structure for the measurement of attitudes and beliefs, in a field which was in relative disarray before their work (Sheppard et al, 1988), the TRA and TPB are not without their limitations. Several researchers have had to modify these models in the study of food choice to include other predictive variables, including **moral obligation** (Raats et al, 1993), **nutritional knowledge** (Shepherd and Stockley, 1985), **attitude ambivalence** (Sparks et al,1992) **self identity** (Sparks and Shepherd, 1992), and **habit.** (Towler and Shepherd, 1991). It is important to acknowledge the models' shortcomings since the basic constructs which only consider intention, attitude, subjective norm and perceived control may not account for all of the variability which explain behaviour.

Attitude-Behaviour Relationship

Both the TRA (Ajzen and Fishbein, 1980) and the TPB (Ajzen, 1988) infer that the most immediate determinants of a person's behaviour is his/her intention to perform the behaviour

in question. Thus, according to Ajzen and Fishbein (1980), behaviour is affected by influencing a person's intentions. However, some researchers argue that the effects of attitudes on behaviour are not always necessarily mediated by intentions. Bentler and Speckart (1979) investigating alcohol, marijuana and hard drug use in 228 college students found that attitudes and previous behaviour contributed strongly to the occurrence of behaviour without the regulation of intentions. Lewis and Booth, (1985) in their study of adult female dieters in the West Midlands found that none of the attitude scores related to following the dieting procedures (established at the beginning of the study) even though attitudes had related to intention to undertake these procedures. This supports the intermediary role of intention (Ajzen and Fishbein, 1980). However, Lewis and Booth (1985) in the same study found, in contrast, that attitude components did significantly account for both weight loss ($p<0.001$) during the diet period and weight maintenance ($p<0.01$). Bagozzi (1981) looking at blood donation behaviour found that ordinarily attitude was mediated by intention, but when the extent of past behaviour was taken into account attitude had a significant effect directly on behaviour. Towler and Shepherd (1991) suggest that perceived control may directly influence behaviour if it is non-volitional behaviour. They cite Schifter and Ajzen (1985) and Ajzen and Madden (1986) who found perceived control to be important in predicting outcome as opposed to actual behaviour (weight loss and grades obtained by college students, respectively). These findings in general appear to point to the importance of factors besides intentions for the prediction of behaviour and outcome. Bentler and Speckart (1979) however, suggest that subjective norm is mediated by intention and does not directly influence behaviour.

Thus, the Theory of Planned Behaviour (Ajzen, 1988) has a number of components: intention, attitude, behavioural belief, normative beliefs, subjective norm, and perceived control which are assumed to be related to each other and eventually to the behaviour. It is the interrelationship of these components with behavioural outcomes which are quantified and measured. An individual's intention to behave in a certain manner serves to predict

behaviour (Ajzen and Fishbein, 1980). It should be stressed however, that although intention is a predictor of behavioural outcome it can sometimes give a poor forecast (Ajzen and Fishbein, 1980). External factors, for example social occasions, illness, and holidays may also effect control (Lewis and Booth, 1985).

Compliance rates may be directly affected by the way the obese view and give values to certain types of foods. However, there is limited information on the attitudes and beliefs of subjects following weight reducing diets (Schifter and Ajzen, 1985, Lewis and Booth, and Saltzer, 1980) with regards to weight loss, dietary adherence and their views on the food components of such diets. This study aims to identify those components which will predict behavioural outcomes or outcome measures, for example weight loss. Further if carbohydrate and fat consumption does influence compliance (see chapter two) can individual components be identified which are predictive of nutrient consumption?

In conclusion, it is apparent that if attitudes and beliefs significantly influence behaviour then their predictive capacity for weight loss and nutrient intake should be explored. Questionnaires measured these concepts at the beginning middle and end of each diet.

Table 1: Studies using the Theory of Reasoned Action or the Theory of Planned Behaviour in the context of food choice or weight loss.

Author/s	Topic/Model	Predictive Components
Saltzer. E. B. (1980)	Social determinants of successful weight loss: an analysis of behavioural intentions and actual behaviour. T.R.A (1975)	• perceived social norms associated with intention and weight loss. • perceived personal consequences were not related to intention or weight loss. • perceived expectations of close friends were most predictive of weight loss.
Beale. D.A. and Manstead. A.S.R. (1991)	Mothers intentions to limit frequency of infants sugar intake. T.P.B. (1988)	• addition of perceived behavioural control resulted in significant increments in the amount of explained variance in intentions. • significant change in attitudes in those in the experimental but not the control group. • the amount of change in intentions was significantly correlated with the amount of change in attitudes, but not with the amount of change in subjective norm or perceived control.

Raats, M.M., Shepherd, R. and Sparks, P. (1993)	Attitudes, obligations and perceived control: Predicting milk selection. T.P.B (1988) and other predictive variables.	• perceived obligation to one's family health was an important predictor of intentions for semi-skimmed milk, and was also an independent predictor of attitudes towards the use of each type of milk. • perceived control made an independent contribution to intention to consume milk, for one of the three milks studied. • subjective norm also had independent effects on intentions (Paisley, et al 1993), but may not have been adequately assessed by their subjective norm measure.
Conner, M. and van Dyck, L. (1993)	Attitudes and beliefs of vegetarians and non-vegetarians. TPB (1988)	• TPB provided good predictors of intention to eat a vegetarian diet (65% of the variability) in the future, although the relationship of intentions to behaviour remains to be explored. • overall attitudes were seen to be the best single predictors with positive attitudes being associated with stronger intentions.
Sparks, P. and Shepherd, R. (1992)	Self identity and attitudes (organic vegetables). TRA (1980)	• a regression of behavioural intentions, attitudes, subjective norm and perceived control revealed significant beta weightings for all the predictor variables. • research supports a body of empirical studies indicating the importance of self identity in the overall structure of the TRA.
Conner, M.T.(1993)	Individualised measurements of attitudes towards foods. (snack foods) TRA (1980) TPB (1988).	• following work on different groups looking at snack food consumption Conner (1993) advocates a more individualised approach to measuring attitudes and beliefs. • the TRA and TPB concerns the individuals beliefs and intentions and the author postulates that individualised methodologies, in which each respondent generates descriptions of influences on their behaviour before rating them, would be a further extension of the model. • Rutter and Bunce (1989), in their study on milk also found some support for individually generated beliefs.

Sparks. P.. Hedderley. D.. and Shepherd. R. (1992)	An investigation into the relationship between perceived control. and attitude variability and the consumption of two common foods. T.R.A. (1980).	• this study takes its lead from work which emphasises the importance of attitude variability and the role of perceived control over action. • within person variability and perceptions of control are examined in the context of peoples attitudes towards consuming two common foods. • took particular notice of 'attitude ambivalence' i.e. the range of attitudes an individual has. regarding different aspects of food. For example. attitudes towards food may include those which relate to taste. health beliefs. cost. and religion. • findings indicated that higher attitude variability was associated with weaker relationships between the components of the TRA and that attitude variability was negatively correlated with perceived control. • perceived control was shown to be related to different sorts of control problems for different behaviours. • it was therefore. advocated that a more in-depth assessment of attitude variability and perceived control is merited. The complexities of the causative factors need to be understood.
Schifter. D. and Ajzen. I. (1985)	Intention. perceived control and weight loss: an application of the TPB	• intentions to lose weight were accurately predicted on the basis of attitudes. subjective norms and perceived control. • perceived control and intentions were together moderately successful in predicting the amount of weight that participants actually lost over 6 weeks. • weight loss was also found to increase with the development of a plan and with ego strength, factors which were assumed to increase control over goal attainment.
Dennison. C.M.. and Shepherd (1995).	Adolescents and food choice: an application of the TPB.	• attitudes and perceptions of control were found to account for the most variance in intentions. • the addition of a novel measure of friend's behaviour increased the models explanatory power further. • self identity played a role in the formation of intentions.

Shepherd. R. and Stockley. L. (1985)	The role of attitudes and nutritional knowledge in fat consumption. TRA (1980).	• nutritional knowledge score did not correlate significantly with the attitude to behaviour, subjective norm or intention. • TRA showed a good prediction of the reported consumption of both the individual foods and the total. • the person's own attitude proved a better predictor of behavioural intention than the subjective norm. • nutritional knowledge score did not relate to attitudes or reported consumption.
Saunders. R. P. and Rahilly. S.A. (1990)	Influences on intention to reduce dietary intake of fat and sugar. TRA (1980)	• sample of university students. health majors and non-health majors. • regression analysis showed that both subjective norm and attitudes towards the behaviour predicted the subjects intention to reduce fat and sugar intake. • for health majors the attitude towards the behaviour was more influential in predicting behavioural intention. • for non-health majors the subjective norm was the most important in predicting behavioural intention.
Shepherd. R. and Stockley. L. (1985)	Fat consumption and attitudes foods with a high fat content. TRA	• the persons own feelings towards consumption of a type of food was a good predictor of consumption. both for the individual type of food and for an index of the foods combined. • pressures from others was found to be less predictive of consumption. • the degree of prediction did not vary between subjects grouped according to sex, age and social class. although there were differences between in consumption and attitudes in these groups.

Shepherd. R. and Farleigh. C.A (1986).	Preferences. attitudes and personality as determinants of salt intake. TRA (1980)	• intention to use table salt use was predicted very well by the individuals attitude and to a lesser extent by perceived social pressure.

1.4.5 Social Implications

Sugar has other connotations within our society. Babies have a strong innate preference for sweet foods (Owen, 1992). However, the sensory effects of sugar are only part of the story. Food is a universally acceptable gift, by means of which the donor expresses a variety of emotions, such as gratitude, concern, sympathy and love. Chocolates and other sweets are used to present to loved ones (Fieldhouse, 1985). Celebrations are often based around foods containing added sucrose, for example, a birthday cake. Meals for social or business occasions may be a three course affair, including dessert. Thus, when added sucrose is traditionally excluded from weight reducing diets it not only incurs physiological deprivation, affecting, for example, appetite (Blundell and Green, 1996), but also social and psychological deprivation. As such it is important not to underestimate the social value of sucrose in our diet and consider the overall effects of excluding this ubiquitous food from the diet

1.5 *Taste, Added Sucrose, Obesity and Dieting*

In general, beliefs concerning taste have been known to be the most important in determining the selection of foods (Shepherd, 1990) and this is significant to the present study. Krondl and Lau (1982) listed the relative importance of factors related to food choice. Taste (flavour) was rated the most important. Shepherd and Farleigh (1986) and Shepherd (1987) in studies on food choice behaviours also suggest the sensory influences are more important than even health benefits. One exception to this being low fat milk, where nutritional benefits rated higher scores as a variable affecting food preference (Shepherd, 1988).

Steiner 1987 (as cited by Rodgers and Blundell, 1990), Sclafani (1995), and Owen (1992) suggest that humans are born with an innate predisposition for sweet taste preference. Others suggest that environmental (Drewnowski et al, 1991), social conditioning (Owen, 1992) and genetic influences have a role in affecting taste preferences for certain foods. Sugar is both psychologically and socially a very desirable food (Gallagher and Allred, 1992). Its removal from the diet creates psychological and social denial which may adversely affect

the individual. For example, Tuschl (1990) suggested that "chronic avoidance of sweet desserts by the habitual dieter was linked with disinhibition and episodes of binge eating". Drewnowski, (1992) suggests that sweet foods are universally regarded as highly palatable and are frequent targets for food cravings. However, whether such cravings occur for sugar or for a mixture of sugar and fat containing foods, is controversial (Drewnowski, 1992).

Some researchers suggest that obese individuals prefer sweet tasting substances in higher quantities than normal weight individuals and that they are particularly unable to restrain themselves in the face of tempting foods (Wurtman et al, 1981 and Yudkin, 1973). As such, these foods are often eliminated from weight reducing diets. However, most subsequent studies reported either no link between sweetness preferences and body weight or a significant relationship in the opposite direction (Drewnowski, 1991). Several researchers argue that obese subjects have a lower sweet preference or an equal preference compared to normal weight subjects (Pangborn and Simone, 1958, and Kaufman et al, 1975). Malcolm et al (1980) and Grinker (1978) similarly fail to reveal differences in sensory preferences between these groups. Thus, the rationale for excluding added sucrose is unclear.

More relevant to this study are changes in sensory responses to foods during weight loss, and they may provide clues as to why compliance to weight reducing diets is reduced. Some studies have shown that the perceived pleasantness of sucrose solutions in water increases following sustained dieting (Cabanac and Ducleaux, 1970) which would have particular implications for those following a weight reducing diet which contained added sucrose. However, others show little support for the notion that preferences for sucrose solutions change in response to shifts in body mass index. Drewnowski (1991) suggests that the perception of sweetness is not related to body fatness nor is it influenced by shifts in energy and metabolic status. He also rejects the conventional concept of the obese 'sweet tooth'. Weight reduction has been reported to improve sweet "aversion" in both adolescent overweight campers and patients with jejuno-ileal bypass surgery (Rodin et al, 1976).

Underwood et al (1973) found that most obese subjects admitted to hospital for weight control rated no aversion to sucrose solutions. Drewnowski (1993) reported that Pangborn and Simone (1958) found that overall liking for the sweet stimuli was unaffected by body-size. Indeed research has shown that high extrinsic sucrose intakes are more likely to be related to low body mass index as documented by (Bolton-Smith and Woodward, 1996). Sensory preferences for fat however, have been associated with body composition (Mela and Sacchetti, 1991). Drewnowski and Holden-Wiltse (1992) suggested that heightened responsiveness to calorie dense foods is associated not so much with elevated body weight per se, but with a pattern of weight loss and weight regain.

The sensory responses to food during weight loss are particularly relevant to the present study in providing clues as to why compliance to weight reducing diets may decrease with duration (Garrow, 1991). The measurement of sensory preferences for added sucrose need to be established (in relation to response to energy deficit and weight reduction) to identify their effects on compliance rates.

1.6 Conclusion

Obesity is difficult to treat and compliance with dietary modification is seen to be the key. Evidence to justify the removal or reduction of commercially added sucrose or foods containing it from weight reducing diets, is sparse and it is postulated that the incorporation of small amounts of these may make the diet more acceptable and increase compliance and weight loss. The attitudes and beliefs and taste preferences of individuals following weight reducing diets which contain added sucrose require investigation before successful dietary prescription can be implemented.

1.7 Hypothesis

'The inclusion of commercially added sucrose in weight reducing diets will increase compliance.'

1.8 AIMS

1.8.1 Overall Aims

- To compare the rates of weight loss of overweight individuals on two isoenergetic energy reduced diets in which the amount of foods containing commercially added sucrose are varied.
- To identify some factors which may affect compliance with an energy reduced diet in which foods containing commercially added sucrose have been deliberately included.
- To examine and compare the reported macro and micronutrient composition of these diets as weight loss proceeds.

1.8.2 Objectives

- To develop two isoenergetic reducing diets which are acceptable to subjects and which contain substantial differences in foods containing commercially added sucrose.
- To measure the reported energy, macro and micronutrients intake of subjects at baseline and after commencing the two diets.
- To compare the attitudes and beliefs of overweight individuals on a weight reducing diet which is inherently sweet due to the inclusion of foods containing added sucrose with a traditional, low fat, low added sucrose diet.
- To establish if taste preferences can be used to indicate adherence to an energy reduced diet.

2.0 CHAPTER TWO

Subjects and Context.

2.1.1. *Selection of Subjects and Sampling*

The sample comprised of volunteers from a large service industry. Subjects were recruited by the researcher with the help of the occupational health nurse. Bulletins were distributed to each department, inviting individuals who were more than 7kg (1stone) in weight above Body Mass Index (BMI) 25 kg/m^2 to join a free slimming programme, which aimed at investigating the palatability of weight reducing diets. A preliminary meeting was set up to give the subjects further details about their involvement (Appendix I) and allow them to complete screening forms (Appendix II) to clarify their suitability for participation.

2.1.2. *Criteria for Selection*

Subjects were included if they were between 20 and 60 years of age, had a B.M.I of 26-35 kg/m^2, were free from any serious or chronic illness which required regular medical and/or dietary supervision and were excluded if they had been following any weight reducing programmes over the previous year. Other variables recorded included age, gender, occupation, onset of obesity and medication taken.

2.1.3 *Sample Size*

Sample size was estimated using a normogram produced by Altman (1992). A sample size of 68 was estimated to have a 90% probability of detecting a real change of 1.0 kg in body weight at the 5% significance level. Ninety-five subjects were recruited to allow for a 25% drop out rate.

2.1.4 *Ethical Approval*

Ethical approval was granted by Queen Margaret College Ethics Committee.

3.0 CHAPTER THREE

Weight Loss, Dietary Compliance and Added Sucrose Consumption.

3.1 Method

3.1.1 *Crossover.*

In the study subjects acted as their own control and were randomly allocated to either Group A or Group B for 8 weeks. Subjects were not familiar with the theoretical concept on which the study was based (that is, to test compliance rates on a diet which allowed foods containing commercially added sucrose compared to one which restricted them). They were simply informed that they would be testing the palatability of the diet (Appendix I). A time period of 16 weeks was chosen, to allow for a weight loss of at least 8 kg (1 stone) at a rate of 0.5-1kg/week (Garrow, 1991).

3.1.2 Construction of Diet Sheets and Evaluation of Current Intake.

The diets designed for the present study were nutritionally balanced providing all the essential nutrients and reduced energy levels. Two isoenergetic diets were designed for a sixteen week weight reducing programme. The Low Sugar Diet (LSD) was a **low added sucrose** (<5% commercially added sucrose), 32% fat diet (Table 2). The Sucrose Containing Diet (SCD) was of equal energy and fat content but, provided 10% energy from **commercially added sucrose**, incorporated in sweet foods (Table 2). The amount of added sucrose in the SCD was determined by recommendations set by the Department of Health (1991). In their report 'Dietary Reference Values for Food Energy and Nutrients for the U.K.' (1991), they proposed that the population's average energy intake of non-milk extrinsic sugars should not provide more than 10% of the energy requirements. These recommendations were used in the absence of guidelines for those following weight reduction diets. As an example, assuming the mean energy requirements for males and females to be 9.4 MJ/d (2,245 kcal/d), an energy reduction of 2.51 MJ/d (600 kcal/d) (Garrow, 1991), would leave 6.8 MJ/d (1,645 kcal/d). Ten percent of energy, therefore, would be derived from 44g added sucrose.

Intense sweeteners were not allowed on either of the diets to prevent subjects using them instead of added sucrose exchanges. Total sugars were not controlled for.

The diet sheets were divided into food groups and set allowances were prescribed in the form of exchanges (Table 2). The number of exchanges allowed depended on the subjects intial energy intake. Group A were subjects placed on the LSD for the first eight weeks, who transferred to the SCD between weeks 9-16 and Group B started the SCD for weeks 1-8, and switched to the SCD for the final eight weeks.

3.1.4 Interviews/Procedure

a. Initial

Prior to the start of the programme subjects were given an information booklet detailing their involvement in the study, and a consent form (Appendix I). They were also requested to keep a 2d record (see section *3.5.2)* of habitual food intake from which energy consumption was calculated. Twenty four hour energy expenditure was predicted by BMR x 1.4 Physical Activity Level (Black 1991) to validate the estimated food record diary (see section *3.5.2).* An energy deficit of 2.51 MJ/day (600kcal/d), below current intake, calculated from estimated food record diaries, was prescribed for each individual to enable a weight loss of 0.5-1kg/wk. Subjects were randomly allocated to either the Group A or Group B for eight weeks.

The use of 'tailor-made' diets for patients have been used in many other studies, and are used by dietitians in the traditional treatment of obesity (Leelarthaepin and Steinbeck, 1980; Stein, Hassanein and Lukert 1981; Gilbert and Garrow, 1983; Long, Simpson and Allot 1983).

Table 2: ***Composition of Prescribed Diets***

Energy/Nutrients	Low Sucrose Diet	Sucrose Containing Diet
Energy MJ (kcal)	6.3 (1500)	6.3 (1500)
Protein g	68.7	61.7
% energy from protein	18.6	16.7
Fat g	52.2	54.5
% energy from fat	31.8	33.2
Carbohydrate g	173.6	173.2
% energy from carbohydrate	44.1	43.9
Alcohol g	11.25	11.25
% energy from alcohol	5.3	5.3
Added sucrose g	5.0	40.0
% energy from added sucrose	1.25	10.0
Fibre NSP g	16.6	13.0
Sodium mg	1917.12	1940.31
Potassium mg	3261.01	3027.20
Calcium mg	1047	977
Iron mg	10.17	10.95
Vitamin A (ret. Eq.) mcg	2346.11	2346.11
Vitamin D mcg	3.55	4.50
Thiamin (B1) mg	1.15	1.41
Riboflavin (B2) mg	1.11	1.59
Vitamin C mg	153	131
Vitamin E mg	8.35	8.35
Folate mg	328.11	403.12
Vitamin B6 mg	1.50	2.17
Vitamin B12 mg	2.70	3.46

b. Follow ups

i) Estimated Dietary Records with Interview (Monitoring Energy and Nutrients).

Subjects were asked to continue to keep food record diaries for two days on weeks 2,4 and 8 of each of the diets (see section *3.5.2*). The days reported included a week day and a weekend day. All subjects were given a record booklet with clear instructions on recording procedures and guidelines on determining the weights of foods (Appendix IV). They completed the diaries using descriptions of average household portions. Individuals were weighed, using regularly calibrated beam balance scales, every fortnight and interviewed to clarify any discrepancies in the diaries or problems recording portions (Hackett et al, 1983). Replica foods were used to illustrate portion sizes.

ii) Monitoring External Factors

At each fortnightly interview, index cards were kept noting down general progress, problems and any external circumstances which may have influenced compliance rates. For example:

-holidays

-emotional problems

-illness

-celebratory events etc.

A short list of standard questions were asked at each interview to elicit these events. (Appendix V).

c. Long term follow ups.

Subjects were followed up 3 months after the end of the 16 week programme to observe any weight changes, and review eating habits.

3.1.5 Anthropometry

a. Weight

The subjects weight was recorded every two weeks. The beam balance (Salter) scales were checked regularly against dead weights. The scales were positioned on a hard floor and subjects were weighed without shoes and in light clothing to an accuracy of +/- 50g. Subjects were requested to empty their bladder before weighing and as far as possible were weighed at a similar time on each occasion.

b. Height

Height was measured using a metre rule positioned on the wall.

c. Body Mass Index (BMI).

BMI was calculated using the following equation:-

$$\text{Body Mass Index (Quetlet Index)} \quad \frac{\text{Weight (kg)}}{[\text{Height (m)}^2]}$$

(Garrow, 1981)

An international classification of BMI (Garrow, 1981) has been widely accepted based on the following arbitrary range of BMI values:

Below 20	-Underweight
20-25 (Grade 0)	Acceptable. This is equivalent to the desirable weight range from insurance company data. It is not associated with health risks.
25-30 (Grade I)	Overweight. This is equivalent to weights approximately 110-120% relative to desirable weights from insurance company data. It does carry some health risks but mainly in subjects less than 50 years old with a family history of either diabetes or hypertension.
30-35 (Grade II)	Obese. This is equivalent to weights of over 120% relative to desirable weights of insurance company data. It is associated with increased morbidity in all age groups.
>35 (Grade III)	Associated with severe health risks.

d. Expected Weight Loss

Expected weight loss was predicted from a knowledge of the relationship between energy deficit and fat tissue loss (Garrow, 1981), on the basis that a reduction in food consumption by 6-700 calories/d would cause the mobilization and use of 100g of adipose tissue, per day. This would lead to the loss of 700-1000 grams of body fat per week or (0.7-1.0kg/week).

3.1.6 Energy Expenditure

Energy expenditure was controlled by verbal discussion with the participants. They were asked to maintain their exercise levels constant throughout the study and this was confirmed at each visit.

3.2 Validation and Reproducibility

3.2.1 Food Record Diaries, Diet Sheets and Instructions.

Estimated food record diaries were validated against subjects BMRx1.4 activity level (Frost et al, 1991) using the Schofield Equation (Schofield, 1985) ***(see section 3.5.2).*** This estimates individual energy requirements. The food record diaries and the diet sheets were also piloted on 21 subjects from a large educational establishment for 16 weeks to check that they were comprehensive and user friendly and that they induced weight loss (Appendix VI). Information booklets which set out details and guidelines about subject involvement in the study, were developed following recommendations from the pilot (Appendix I).

3.3 Analysis

3.3.1. Food Scoring System

Analysis of food record diaries was initially carried out using COMP-EAT 4. However, since this procedure was very time consuming a food scoring system was developed from data obtained from 'The Royal Society of Chemistry' based on 'The Composition of Foods' (McCance and Widdowson, 1992) and COMP-EAT 4 nutritional analysis package (Nutrition Systems). The scoring system *(*Appendix VII*)* was seen to reduce analysis time to about 20 minutes. At a later date all of the diaries were analysed using COMP-EAT 4 so that a comparison between the two methods could be made (Appendix VIII). The commercially added sucrose content of foods were obtained from data provided by the Dunn Clinical Nutrition Centre.

3.3.2 COMP-EAT 4

Correlation coefficients were calculated to compare the results of the food scoring system with the results of the diaries analysed using COMP-EAT 4 (Appendix VIII).

3.3.3 Expression of Results

Results were expressed for Group A and B and also male and females within each group.

3.3.4 Statistical Analysis

Statistical analysis was carried out using SPSS for Windows. Means and standard errors of means were calculated for nutritional and anthropometric data. Intra-group differences between baseline and week 8 values were assessed using the paired Student's t-test. Inter-group differences between Group A and Group B at baseline, at week 8 and week 16 were assessed using the independent Student's t-test.

3.4 Results

3.4.1 Personal anthropometric and demographic data

Table 3 shows personal anthropometric and demographic data. There were seen to be no significant differences between Group A and Group B. Characteristics of those who dropped out showed them to be heavier and younger than those who followed the programme through. Forty-seven females were recruited for the study and of these thirteen (27%) dropped out leaving thirty four to complete the programme. Forty-eight males were recruited and of these fourteen (29%) dropped out, leaving thirty four. Only those subjects who completed all the components of the programme were included in analysis.

3.4.2 Preliminary Pilot Results

a) Diet Sheets

The pilot studies showed there to be no major problems in understanding the diet sheets or with the layout of them, although, it was suggested that they would be more user friendly in a smaller booklet format (Appendix VI). As such, booklets were produced for the study proper. Subjects found the instructions to be comprehensive and easy to follow.

b) Food Record Diaries

Subjects found the instructions in the diaries straight forward and easy to understand. However, there were some discrepancies in portion sizes which were usually clarified at the interview when the diaries were collected. It was thought that the use of food models would have been useful and as such were used to illustrate portion sizes in the study proper.

3.4.3 Completion of Food Record Diaries

Table 4 summarises the food record diary response rate. Responses were generally very good. The mean percentage of subjects returning diaries in Group A was 93% between weeks 0-8 and 94% between weeks 9-16 and in Group B, 97% between weeks 0-8 and

94% during the last eight weeks. Most subjects were highly motivated and returned their diary every two weeks, whereas, other respondents needed constant reminding and external factors such as holidays, family celebrations or emotional reasons were given as excuses for not recording intake and may have influenced the completion and return. In the follow up study most of the diaries were not returned, and therefore, analysis of dietary intake after the programme had finished was not possible.

3.4.4 Weight Loss as an Indicator of Compliance.

There was no significant difference in the initial weights of subjects in Group A and B (Table 5a). Body weight decreased significantly on both diets during the first eight week block by 2.2 kg on the LSD and 3.0 kg on the SCD. However, the difference in actual change in weight between the groups at week 8 and week 16 was not significant. Predicted weight loss was compared with actual weight loss. A calculation was undertaken, to predict weight loss (see section *3.1.5.d*) The prescribed 2.51 MJ/d (600 kcal/d) deficit, 140.58MJ/d (33,600 kcal) over eight weeks would lead to weight loss of 4.8 kg. Analysis of food diaries indicated that subjects claimed to have a deficit of 3.52 MJ/d (842 kcal/d) which could lead to weight loss of 6.9kg over eight weeks (Garrow, 1981). A "compliance rate" was then calculated as a percent of actual weight loss versus predicted weight loss for each individual as indicated above. This calculation indicates a mean "compliance rate" of 33% on the LSD and 43% on the SCD. There was no significant difference in compliance rates between the two groups.

Gender groups between weeks 1-8 showed highly significant weight loss ($p<0.001$) on the SCD (females -2.8kg and males -3.4kg). Body weight also decreased in both men and women on the LSD during this period but to a lesser degree in females (males -2.8kg, $p<0.01$, females -1.4kg, $p<0.05$), (see Table 5b). However, there was no significant

difference in change in weight between the female groups or the male groups on each diet at each time period.

Weight loss was poor between weeks 9-16 for total subjects on both diets (Table 8). Table 5b. shows that there were no weight changes for the females on each diet or the males following the LSD during this period. However, there was a significant weight loss in the male group on the SCD (1.1kg, $p<0.05$).

Weight loss occured over the 16 week period . Mean weight loss on the LSD was -2.1 kg and on the SCD was -3.4 kg . The difference between the groups was not significant. (Table 5a).

3.4.5 Estimated Energy Requirements

The average ratio of reported energy intake to basal metabolic rate EI:BMR was 1.3 in both groups (Table 5a, - see section *3.5.2*). A significant correlation was found to exist between energy requirements as estimated by BMRx1.4 (physical activity level) (Black, 1991) and the food record diary method (Pearson's $r = 0.58$, $p<0.001$). The ninety five percent limits of agreement (Altman, 1994) indicated that for the group there was a slight bias towards under reporting or under eating (Macdiarmid and Blundell, 1997) on the days recorded (mean difference was -164 kcal). At the individual level the error ranged from 853 kcals to -1181 kcal which would indicate both under reporting or under eating (see section *3.5.2*) and over reporting.

3.4.6 Macronutrient Intake.

No significant differences in initial energy, fat, carbohydrate, protein, alcohol, total sugars and added sucrose intake were found between the two groups (Table 6b). At week 8, in Group B_{SCD} there was no significant change from percentage energy from added sucrose at

baseline (9.6%-9.0%) but a significant decrease in percentage energy from fat (36.0% to 31.7%, $p<0.05$), which did not occur in Group A_{LSD}. Also there was a significant increase in total carbohydrate in Group B_{SCD} (40.1% to 45.0%, $p<0.01$) (Table 6c). Alcohol levels expressed as percent energy were seen to drop significantly on both diets by week 8, from 9.7% to 3.9% on the LSD $p<0.01$ and from 8.4% to 3.6% on the SCD $p<0.05$ (see Table 6c).

Figure 2 (p52) uses bar charts to represent nutrient intake in grams and shows that their is minimal variation in weekly intake within each group between weeks 2 to 8.

The only significant differences in change in macronutrient intake between the two groups were for percentage energy provided by added sucrose (LSD 3.6%, SCD 0.6%, $p<0.05$) and total sugars (LSD +1.3, SCD +7.39, $p<.0.001$) at week 8.

When energy density was calculated excluding alcohol, (Table 6d), results show that percentage energy from fat decreased on the SCD (39.0% to 33.0%, $p<0.05$) at the end of the first eight weeks, but not on the LSD. Carbohydrate was also seen to significantly increase ($p<0.05$) on this diet, but not on the LSD.

Differences were also noted in macronutrient consumption within the gender groups (Tables 7a and 7b). Females on the SCD were seen to reduce their percentage energy from fat between baseline and week 8, ($p<0.05$). There were seen to be significant changes in grams of fat on both diets in both the male ($p<0.001$) and female groups (LSD $p<0.01$), SCD $p<0.001$). Percent energy provided by commercially added sucrose dropped significantly on the LSD for males, but not females and also in grams (LSD,$p<0.01$, SCD, $p<0.05$ females - LSD, $p<0.001$, SCD $p<0.05$ males). Percent energy from carbohydrate increased slightly ($p<0.05$) for both the male groups and the females on the SCD. In grams there was a highly

significant increase in carbohydrate for the males on both diets ($p<0.001$) and to a lesser extent in both female groups ($p<0.05$). Males on both diets were seen to significantly reduce their percentage energy from alcohol by week 8 $p<0.01$ (see Table 7b).

3.4.7 Under-reporting, weeks 9-16.

Interpretation of nutrient data between weeks 9-16 was not possible due to suspected under reporting (see section *3.5.2)*, after the switch over period (Table 8). Under reporting by overweight and obese subjects is well documented (Jebb and Prentice, 1996; Prentice et al, 1986 and Black et al, 1991). Under reporting may have occurred in the present study because there was no weight loss on the LSD and only a very small weight loss on the SCD during this period. However, substantial energy deficits, which would ordinarily have promoted weight loss similar to that lost between weeks 1-8, were recorded.(Table 8). It is possible that subjects may have had a substantial energy deficit on the 2 days they recorded, but ate more on the remaining five days so that weight loss would not be achieved. Under eating as opposed to under reporting was, therefore, a possibility (Macdiarmid and Blundell, 1997).

3.4.8 Reported Micronutrient Intake.

Reported micronutrient intake (expressed as absolute values, Table 9a) showed few significant changes between initial intake and week 8. The main ones were a reduction in calcium ($p<0.001$) and iron ($p<0.01$) on the LSD and an increase in vitamin C ($p<0.05$). On the SCD there was a significant rise in vitamin C ($p<0.001$) and a decrease in vitamin E ($p<0.001$).

There was also a significant difference in vitamin A at week 8 between the LSD and the SCD (Table9b). The latter had a significantly lower intake of vitamin A compared to the LSD at week 8. The only difference in change in micronutrient intake (Table 9c.) at week 8

between the LSD and the SCD was in vitamin C. The latter having a significantly higher intake than the LSD ($p<0.05$).

The micronutrient data has only been presented to indicate trends. It is recognised that more days diaries would be needed to allow for meaningful statistical comparisons. Whether the levels reached Recommended Nutrient Intakes (RNI's) was also considered, although this presented difficulties because the RNI's are set for the general population and not for those following energy reduced diets. However, when calculated to look at nutrient density (mg/MJ) most of the micronutrients in both groups showed increases. Both showed that calcium ($p<0.01$ LSD, $p<0.001$ SCD), thiamin ($p<0.001$) and riboflavin ($p<0.01$ LSD, $p<0.001$ SCD) increased significantly at week 8 compared to baseline. On the LSD zinc ($p<0.001$) and on the SCD iron ($p<0.001$) and vitamin C ($p<0.001$) also significantly increased. There was seen to be a change in vitamin A consumption at week 8, (similar to the absolute levels) between the LSD and SCD. The latter had a reduced intake of Vitamin A from baseline, compared to the LSD. All other micronutrient values when measured as mg/MJ on both diets were above RNI recommendations.

3.4.9 Long Term Follow-ups

Only 32 subjects (19, from Group A and 13, from Group B) returned to be weighed three months after the completion of the diets. Fewer still (7 from Group A, and 4, from Group B) completed and returned food record diaries. As such, because of small numbers it is only possible to comment on trends in weight change. The diaries were not analysed because the number of those returned was too small to be statistically reliable. (Table 10).

At week 8 subjects from both groups were seen to lose a significant amount of weight from baseline. Between weeks 1-8 subjects lost 2.2 kg on the LSD compared to 3.0 kg on the SCD. At weeks 9-16 when subjects had switched diets, those on the SCD were seen to lose

0.4 kg, and those on the LSD actually gained weight, +0.09 kg. However, both groups were seen to gain weight between week 16 and the three month follow up (+1.6 kg Group A and + 1.3 kg Group B). Because the numbers in each group are very different they could not be compared.(Table 10). It is however, interesting to note that more subjects who finished the programme on the SCD returned to be weighed and completed their diaries for the three month follow up, than those subjects who finished on the LSD (Table 10).

Table 3: *Personal anthropometric and demographic data of 95 subjects (mean +s.d).*

MALES

	LSD				SCD			
	Completers n=20		Dropouts n=8		Completers n=14		Dropouts n=6	
	Mean	s.d	Mean	s.d	Mean	s.d	Mean	s.d
Initial weight (kg)	92.5	+ 9.2	92.0	+11.9	92.1	+ 8.4	98.0	+ 12.0
Height (m)	1.77	+ 7.4	1.75	+0.1	1.77	+ 8.4	1.76	+ 0.1
Body Mass Index (kg/m²)	30	+ 1.9	30	+4.0	29	+ 2.3	31	+ 3.0
Age (years)	42	+ 10.4	41	+3.7	37	+8.5	34	+ 9.0

FEMALES

	LSD				SCD			
	Completers n=15		Dropouts n=4		Completers n=19		Dropouts n=9	
	Mean	s.d	Mean	s.d	Mean	s.d	Mean	s.d
Initial weight (kg)	71.9	+ 8.3	78.0	+ 14.9	79.0	+ 13.1	80.4	+ 16.3
Height (m)	1.58	+ 7.1	1.59	+ 0.3	1.61	+ 5.3	1.57	+ 0.1
Body Mass Index (kg/m²)	29	+ 2.6	31	+ 4.6	31	+ 4.9	32	+ 5.0
Age (years)	42	+ 11.1	37	+ 6.7	37	+ 11.5	36	+ 7.8

No significant differences were observed between the LSD and SCD for these variables.

Table 4 : ***Total food record diaries completed by the 68 subjects who commenced the programme.***

Subjects	Prestudy	Week 2	Week 4	Week 8	Week 10	Week 12	Week 16
Group $A_{LSD-SCD}$ n=35	34 (97)	33 (94)	32 (91)	33 (94) mean =33	34 (97)	32 (91)	33 (94) mean=33
Group $B_{SCD-LSD}$ n=33	33 (100)	33 (100)	30 (90)	33 (100) mean=32	32 (97)	31 (94)	31 (91) mean=31

(percentages in brackets).

Table 5a : ***Mean weight loss and Body Mass Index (BMI) of subjects completing the 8 week programme + s.d.***

	Group A LSD n=35		Group B SCD n=33		Differenceh etween groups P
	Mean	s.d	Mean	s.d.	
Initial weight (kg)	83.7	± 13.5	84.5	± 13.2	N/S
Weight week 8 (kg)	81.5	± 13.1	81.5	± 12.7	N/S
Difference over time within groups P	<0.001		<0.001		
Weight change (kg)	-2.2	± 3.0	-3.0	± 2.5	N/S
EI:BMR	1.3	± 0.3	1.3	± 0.2	N/S
Initial B.M.I (kg/m^2)	29.2	± 2.3	30.1	± 4.0	<0.01
B.M.I week 8 (kg/m^2)	28.2	± 3.8	28.8	± 3.8	<0.05
Difference over time within groups P	<0.001		<0.001		
BMI change (kg/m^2)	1.0	± 1.2	1.3	± 1.6	N/S
	Group A SCD n=35		Group B LSD n=33		
Weight week 8 (kg)	81.5	± 13.1	81.5	± 12.7	N/S
Weight week 16 (kg)	81.1	± 12.6	81.6	± 12.4	N/S
Weight change (kg)	-0.4	± 1.6	+0.09	± 1.6	N/S
BMI week 8 (kg/m^2)	28.2	± 3.8	28.8	± 3.8	N/S
BMI week 16 (kg/m^2)	28.1	± 2.4	28.8	± 3.5	N/S
Difference over time within groups P	N/S		N/S		
BMI change (kg/m^2)	0.1	± 0.7	0.2	± 1.73	N/S

Weight was recorded at fortnightly intervals on calibrated scales; t-tests were used to assess differences between the groups.

Table 5b: *Mean weight loss and Body Mass Index (BMI) of subjects by gender + s.d*

FEMALES

	LSD n=15		SCD n=19		Difference between groups *P*
	Mean	s.d	Mean	s.d	
Initial weight (kg)	71.9	± 8.3	78.7	± 13.1	N/S
Weight week 8 (kg)	70.5	± 8.5	75.9	± 12.7	N/S
Difference over time within the group P	<0.05		<0.001		
Weight change week 8 (kg)	-1.4	±2.8	-2.8	± 2.3	N/S
Initial BMI (kg/m²)	28.6	±2.6	30.8	± 4.9	N/S
BMI week 8 (kg/m²)	27.7	± 2.8	29.2	± 4.5	N/S
Difference over time within the group P	<0.05		<0.01		N/S
BMI change (kg/m²)	0.92	± 0.9	1.57	± 1.9	
	SCD n=15		LSD n=19		
	Mean	s.d	Mean	s.d	*P*
Weight week 8 (kg)	70.5	± 8.5	75.9	± 12.7	N/S
Weight week 16 (kg)	70.1	± 10.5	75.7	± 11.6	N/S
Weight change week 16 (kg)	-0.4	± 1.3	-0.2	± 1.6	N/S
Difference over time within the group P	N/S		N/S		
BMI week 8 (kg/m²)	27.7	± 2.8	29.2	±4.5	N/S
BMI week 16 (kg/m²)	27.9	± 3.0	29.2	± 4.0	N/S
Difference over time within the group P	N/S		N/S		
BMI change (kg/m²)	+0.2	± 0.5	0.01	± 2.15	N/S

5b: continued: MALES

	LSD Mean	s.d	SCD Mean	s.d	Difference between groups P
Initial weight (kg)	92.5	± 9.2	92.1	± 8.9	N/S
Weight week 8 (kg)	89.7	± 9.0	88.7	± 8.8	N/S
Difference over time within the group P	<0.01		<0.001		
Weight change week 8 (kg)	-2.8	± 3.6	-3.4	± 2.7	N/S
Initial BMI (kg/m²)	29.7	± 1.9	29.2	± 2.3	N/S
BMI week 8 (kg/m²)	28.5	± 1.8	28.33	± 2.3	N/S
Difference over time within the group P	0.001		0.001		
BMI change (kg/m²)	1.2	± 1.36	0.95	± 0.8	N/S
	SCD Mean	s.d	LSD Mean	s.d	P
Weight week 8 (kg)	89.7	± 9.0	88.7	± 8.8	N/S
Weight week 16 (kg)	88.6	± 10.0	88.7	± 9.0	N/S
Difference over time within the group P	<0.05		N/S		
Weight change week 16 (kg)	-1.1	± 1.6	0	± 1.4	N/S
BMI week 8 (kg/m²)	28.5	± 1.8	28.3	± 2.4	N/S
BMI week 16(kg/m²)	28.2	± 1.9	28.3	± 2.6	N/S
Difference over time within the group P	<0.05		N/S		
BMI change (kg/m²)	0.3	± 63	0	± 0.5	N/S

Table 6a: ***Mean reported energy consumption of subjects completing the programme (weeks 1-8) from the 6 day food record diaries + s.d. (Figures include alcohol).***

	LSD n=35		SCD n=33		Difference between groups
	Mean	s.d	Mean	s.d	*P*
Reported energy intake at baseline MJ (kcal/day)	9.3 (2221)	±2.8 (686)	9.3 (2235)	±2.3 (554)	N/S
Diet prescription MJ (kcal/day)	7.0 (1674)	±2.4 (577)	6.9 (1655)	±2.0 (493)	N/S
Reported energy intake week 8 MJ (kcal/day)	5.6 (1348)	±1.5 (373)	5.9 (1429)	±1.6 (397)	N/S
Reported energy deficit MJ (kcal/d) at week 8	3.7 (879)	±2.8 (670)	3.4 (806)	±2.9 (691)	N/S

Table 6b: ***Mean reported nutrient consumption (in grams) of subjects completing the programme (weeks 1-8) from the 6 day food record diaries. (Figures include alcohol)***

	LSD n=35 Mean	s.d	SCD n=33 Mean	s.d	Difference between groups P
Reported sucrose intake at baseline (g)	47.0	±32	57.0	±36	N/S
Reported sucrose intake at week 8 (g)	16.0	±19	34.0	±19	0.001
P (difference between baseline and week 8)	**<0.001**		**<0.01**		
Change in reported sucrose intake week 8 (g)	31.0	±32.5	23.0	±39.4	N/S
Reported fat intake at baseline (g)	89.1	±27	88.0	±28.0	N/S
Reported fat intake at week 8 (g)	54.1	±24.9	51	±22.0	N/S
P (difference between baseline and week 8)	**<0.001**		**<0.001**		
Change in reported fat intake week 8 (g)	35.0	±36.9	37.0	±28.8	N/S
Reported protein intake at baseline (g)	78.2	±22.4	76.3	±24.2	N/S
Reported protein intake at week 8 (g)	65.0	±44.4	74.8	±53.6	N/S
P (difference between baseline and week 8)	**<0.05**		**N/S**		
Change in reported protein week 8 (g)	12.2	±40.7	1.5	±53.0	N/S
Reported carbohydrate intake at baseline (g)	230.0	±76.0	238.0	±66.0	N/S
Reported carbohydrate intake at week 8 (g)	148.1	±43.0	170.0	±46.0	N/S
P (difference between baseline and week 8)	**<0.001**		**<0.001**		
Change in reported carbohydrate week 8 (g)	82.0	±83.4	60.1	±79.7	N/S
Reported alcohol intake at baseline (g)	30.9	±40.0	27.1	±37.4	N/S
Reported alcohol intake at week 8 (g)	7.5	±16.2	7.3	±20.6	N/S
P (difference between baseline and week 8)	**<0.01**		**<0.05**		
Change in reported alcohol week 8 (g)	23.4	±38.7	19.7	±39.5	N/S
Reported total sugars intake at baseline (g)	82.7	±29.5	85.8	±47.4	N/S
Reported total sugars intake at week 8 (g)	54.9	±27.5	84.9	±23.2	<0.001
P (difference between baseline and week 8)	**<0.001**		**N/S**		
Change in reported total sugars week 8 (g)	27.7	±36.7	0.9	±50.9	N/S

Table 6c: *Mean reported percentage energy from macronutrients of subjects completing the programme weeks 1-8) estimated from the 6 day food record diaries. (Figures include alcohol)*

	LSD n=35 Mean	s.d	SCD n=33 Mean	s.d	P
Reported sucrose intake at baseline (%E)	8.0	±3.9	9.6	±5.6	N/S
Reported sucrose intake at week 8 (%E)	4.4	±4.3	9.0	±4.9	<0.001
P (difference between baseline and week 8)	<0.001		N/S		
Change in sucrose intake week 8 (%E)	3.6	±4.67	0.6	±6.91	<0.05
Reported fat intake at baseline (%E)	36.3	±13.8	36.0	±8.18	N/S
Reported fat intake at week 8 (%E)	35.4	±11.6	31.7	±8.91	N/S
P (difference between baseline and week 8)	N/S		<0.05		
Change in fat intake week 8 (%E)	0.9	±11.7	4.3	±9.6	
Reported carbohydrate intake at baseline (%E)	39.0	±7.9	40.1	±7.2	N/S
Reported carbohydrate intake at week 8 (%E)	41.1	±10.6	45.0	±8.6	N/S
P (difference between baseline and week 8)	<0.01		<0.01		
Change in carbohydrate intake week 8 (%E)	+2.1	±10.79	+5.0	±9.80	N/S
Reported protein intake at baseline (%E)	14.88	±3.9	14.4	±5.5	N/S
Reported protein intake at week 8 (%E)	19.5	±11.5	20.4	±12.5	N/S
P (difference between baseline and week 8)	N/S		N/S		
Change in protein intake week 8 (%E)	+4.9	±11.5	+6.0	±12.9	N/S
Reported alcohol intake at baseline (%E)	9.7	±10.1	8.4	±9.1	
Reported alcohol intake at week 8 (%E)	3.9	±11.2	3.6	±10.3	N/S
P (difference between baseline and week 8)	<0.01		<0.05		
Change in alcohol intake week 8 (%E)	5.8	±8.1	4.7	±6.7	N/S
Reported total sugars intake at baseline (%E)	14.0	±6.2	14.3	±6.3	N/S
Reported total sugars intake at week 8 (%E)	15.3	±5.6	22.2	±7.3	<0.001
P (difference between baseline and week 8)	N/S		<0.001		
Change in total sugars intake week 8 (%E)	+1.3	±0.4	+7.3	±7.8	<0.001

Table 6d : ***Mean reported food energy from macronutrients (weeks 1-8) from the 6 day food record diaries (excluding alcohol)***

	LSD n=35		SCD n=33		
	Mean	s.d	Mean	s.d	*P*
Reported sucrose intake at baseline %E	8.7	4.5	10.1	5.9	
Reported sucrose intake at week 8 %E	4.6	4.3	9.3	4.7	<0.001
p	<0.001		N/S		
Reported fat intake at baseline %E	40.5	14.2	39.0	15.5	N/S
Reported fat intake at week 8 %E	36.7	11.9	33.0	7.1	N/S
p	N/S		<0.05		
Reported carbohydrate intake at baseline %E	42.7	6.4	44.0	6.8	N/S
Reported carbohydrate intake at week 8 %E	43.3	10.2	46.0	11.2	N/S
P	N/S		<0.05		
Reported protein intake at baseline %E	16.0	4.6	16.0	5.4	
Reported protein intake at week 8 %E	20.4	11.7	21.0	13.2	N/S
	N/S		<0.01		

Fig. 2: ***Bar charts of reported energy and nutrient consumption (in grams) between weeks 1-8***

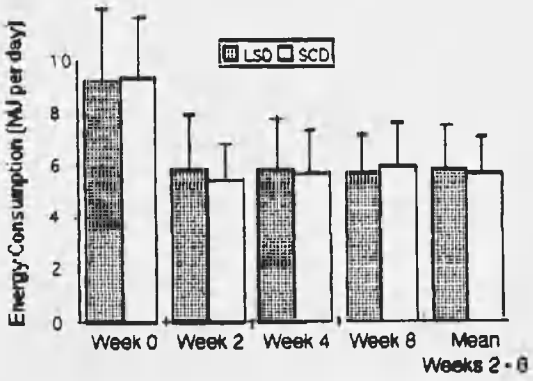


Fig 2a: Mean reported energy consumption (MJ/day) of subjects completing the programme (weeks 1-8) from the 6 day food record diaries ± s.e.m. (Figures include alcohol).

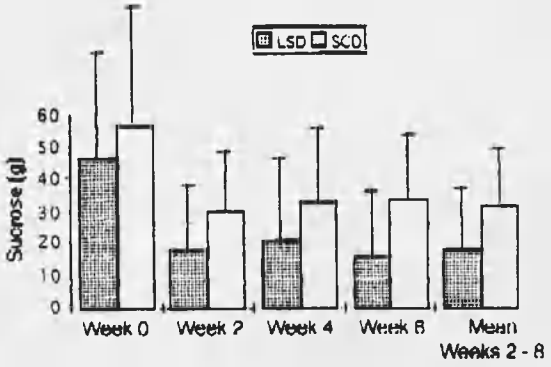


Fig 2b: Mean reported sucrose consumption (g) of subjects completing the programme (weeks 1 - 8) from the 6 day food record diaries. (Figures include alcohol).

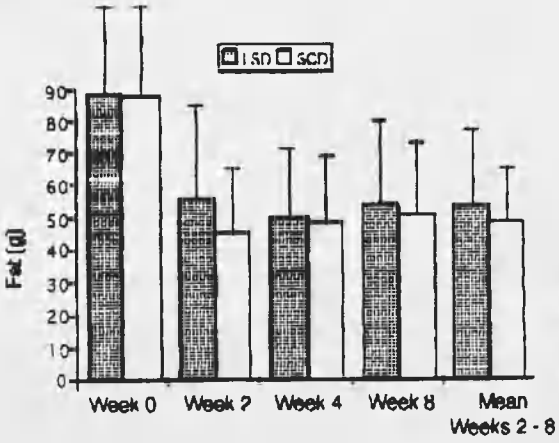


Fig 2c: Mean reported fat consumption (g) of subjects completing the programme (weeks 1 - 8) from the 6 day food record diaries. (Figures include alcohol).

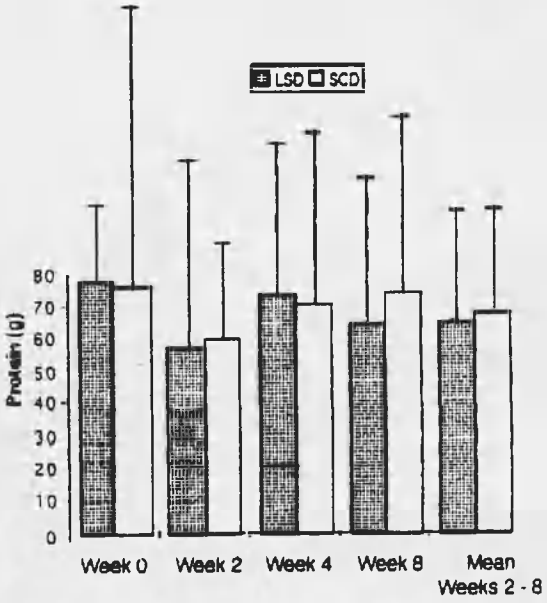


Fig 2d: Mean reported protein consumption (g) of subjects completing the programme (weeks 1 - 8) from the 6 day food record diaries. (Figures include alcohol).

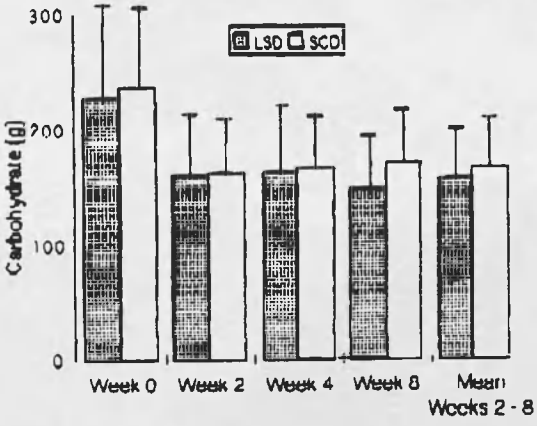


Fig 2e: Mean reported carbohydrate consumption (g) of subjects completing the programme (weeks 1 - 8) from the 6 day food record diaries. (Figures include alcohol).

Table 7a : *Gender differences in reported percentage energy from macronutrients (weeks 1-8) estimated from food record diaries + s.d.*

FEMALES

Macronutrients	Group A [illegible]		Group B [illegible]		Difference between groups *P*
	Mean	s.d	Mean	s.d	
Fat intake at baseline (g)	78.0	± 21.9	86.0	+ 1.7	N/S
Fat intake at week 8 (g)	54.0	± 16.0	50.2	+ 19.7	N/S
P	<0.01		<0.001		
Fat intake at baseline (%E)	41	± 13.1	39.0	+ 2.1	N/S
Fat intake at week 8 (%E)	36.2	± 6.5	32.2	+ 7.6	N/S
P	N/S		<0.05		
Sucrose intake at baseline (g)	32.0	± 23.0	52.0	+ 40.8	N/S
Sucrose intake at week 8 (g)	16.0	± 22.0	33.1	+ 17.5	N/S
P	<0.01		<0.05		
Sucrose intake at baseline (%E)	6.0	± 3.89	10	+ 6.8	N/S
Sucrose intake at week 8 (%E)	4.29	± 5.48	9.19	+ 4.9	<0.05
P	N/S		N/S		
Carbohydrate intake at baseline (g)	203.0	± 69.7	217.0	+72.3	N/S
Carbohydrate intake at week 8 (g)	153.1	± 47.0	163.6	+ 43.1	N/S
P	<0.05		<0.05		
Carbohydrate intake at baseline (%E)	41.0	± 9.4	41.0	+ 6.9	N/S
Carbohydrate intake at week 8 (%E)	44.0	± 9.9	45.6	+ 8.0	N/S
P	N/S		<0.05		
Protein intake at baseline (g)	67.8	± 17.8	72.3	+ 24.7	N/S
Protein intake at week 8 (g)	58.6	± 12.8	69.2	+ 59.8	N/S
P	N/S		N/S		
Protein intake at baseline (%E)	15.0	± 5.2	15.3	+ 6.2	N/S
Protein intake at week 8 (%E)	18.2	± 3.7	18.7	+13.6	N/S
P	N/S		N/S		
Alcohol intake at baseline (g)	12.1	± 16.0	11.6	+14.9	N/S
Alcohol intake at week 8 (g)	3.21	± 6.7	4.5	+5.7	N/S
P	<0.01		<0.01		
Alcohol intake at baseline (%E)	3.8	± 5.0	4.7	+4.8	N/S
Alcohol intake at week 8 (%E)	1.6	± 3.4	2.8	+3.1	N/S
P	N/S		N/S		

Table 7b: **MALES**

Macronutrients	Group A [illegible] Mean	s.d	Group B [illegible] Mean	s.d	Difference between groups *P*
Fat intake at baseline (g)	95.0	+25.9	93.0	+30.2	N/S
Fat intake at week 8 (g)	53.7	+28.4	52.2	+24.2	N/S
P	<0.001		<0.001		
Fat intake at baseline (%E)	34.5	+4.1	33.0	+4.7	N/S
Fat intake at week 8 (%E)	33.3	+6.76	31.0	+4.3	N/S
P	<0.001		N/S		
Sucrose intake at baseline (g)	58.0	+32.2	61.1	+30.4	N/S
Sucrose intake at week 8 (g)	16.0	+15.2	34.5	+20.6	<0.01
P	<0.001		<0.05		
Sucrose intake at baseline (%E)	8.3	+3.6	9.0	+3.6	N/S
Sucrose intake at week 8 (%E)	3.8	+3.0	8.7	+4.8	<0.01
P	<0.001		N/S		
Carbohydrate intake at baseline (g)	250.5	+75.8	266.2	+45.1	N/S
Carbohydrate intake at week 8 (g)	146.7	+41.6	178.1	+46.5	
P	<0.001		<0.001		
Carbohydrate intake at baseline (%E)	37.3	+6.5	40.0	+6.4	N/S
Carbohydrate intake at week 8 (%E)	42.3	+7.7	45.0	+5.1	N/S
P	<0.05		<0.05		
Protein intake at baseline (g)	87.63	+21.4	81.8	+17.1	N/S
Protein intake at week 8 (g)	71.22	+53.6	82.4	+39.6	N/S
P	N/S		N/S		
Protein intake at baseline (%E)	15.0	+3.0	13.2	+3.3	N/S
Protein intake at week 8 (%E)	20.7	+13.3	22.0	+10.1	N/S
P	N/S		<0.05		
Alcohol intake at baseline (g)	45.2	+43.5	48.0	+43.2	N/S
AlcoholIntake at week 8 (g)	8.31	+18.6	6.2	+14.0	N/S
P	0.001		<0.001		
Alcohol intake at baseline (%E)	12.6	+10.4	13.3	+11.2	N/S
Alcohol intake at week 8 (%E)	4.0	+7.1	2.5	+6.1	N/S
P	<0.01		<0.01		

Table 8: *Mean reported nutrient and energy intake (weeks 9-16) + s.d*

	Group B_{sco} n=33		Group A_{sco} n=35		Difference between groups P
	Mean	s.d	Mean	s.d	
Energy intake at baseline MJ	9.3 (2235)	+ 2.3 (554)	9.3 (2221)	+2.8 (686)	N/S
Diet prescription MJ (kcal)	6.9 (1655)	+ 2.0 (493)	7.0 (1674)	+2.4 (577)	N/S
Reported energy deficit MJ (kcal)	3.2 (778)	+ 2.8 (683)	3.4 (813)	+2.8 (668)	N/S
Weight loss (kg)	+0.09	+ 1.6	-0.4	+1.6	N/S
Sucrose intake at baseline(g)	57.0	+ 36.4	47.0	+32.2	N/S
Sucrose intake at week 8 (g)	29.0	+ 20.8	30.0	+16.5	N/S
P	0.001		<0.01		
Sucrose intake at baseline(%E)	9.6	+ 5.6	8.0	+3.9	N/S
Sucrose intake at week 8 (%E)	8.1	+5.2	8.0	+4.7	N/S
P	N/S		N/S		
Fat intake at baseline (g)	88.0	+ 23.5	89.0	+28.0	N/S
Fat intake at week 8 (g)	53.0	+ 30.6	57.0	+23.0	N/S
P	<0.001		<0.001		
Fat intake at baseline (%E)	36.0	+ 1.8	36.3	+5.8	N/S
Fat intake at week 8 (%E)	34.0	+ 1.7	36.1	+12.8	N/S
P	N/S		N/S		
Carbohydrate at baseline (g)	238.0	+ 66.1	230.0	+78.8	N/S
Carbohydrate at week 8 (g)	172.0	+ 62.59	157.0	+35.4	N/S
P	<0.001		<0.001		
Carbohydrate at baseline (%E)	40.1	+ 7.2	39.0	+7.9	N/S
Carbohydrate at week 8 (%E)	45.0	+ 7.6	43.0	+10.9	N/S
P	<0.01		N/S		

Table 9a *Reported micronutrient intake between baseline & week 8 (absolute values) + standard deviation.*

LSD n=35

Micronutrients	Initial		Week 8		P	Change between initial and week 8	
	Mean	s.d	Mean	s.d		Mean	s.d
Calcium (mg)	879.49	322.95	674.18	167.79	<0.001	205.31	324.26
Iron (mg)	12.87	5.75	10.21	2.81	<0.01	2.66	5.56
Vit A (µg)	1036.74	1159.76	1057.93	1159.76	N/S	+21.19	442.63
Vit C (mg)	51.77	51.20	58.44	31.86	<0.05	+ 6.67	48.34
Vit D (µg)	4.56	8.78	2.16	1.62	N/S	2.40	8.65
Vit E (mg)	6.89	9.44	3.19	1.39	<0.05	3.70	9.24
Zinc (mg)	7.90	3.0	7.70	2.13	N/S	0.2	3.64
Thiamin (mg)	1.13	0.38	1.07	2.41	N/S	0.06	0.36
Riboflavin (mg)	1.71	0.86	1.57	0.88	N/S	0.14	1.20
Folate (mg)	223.94	104.79	190.27	52.10	N/S	33.67	109.08
Vit B6 (mg)	1.67	0.72	1.61	0.37	N/S	0.06	0.73
Vit B12 (mg)	7.28	10.36	5.25	3.30	N/S	2.03	10.57

SCD n=33.

Micronutrients	Initial		Week 8		P	Change between initial and week 8	
	Mean	s.d	Mean	s.d		Mean	s.d
Calcium (mg)	802.76	312.57	703.48	232.91	N/S	99.28	311.25
Iron (mg)	12.56	5.49	10.87	3.60	N/S	1.69	4.91
Vit A (µg)	642.67	7.11	544.42	292.5	N/S	98.25	745.70
Vit C (mg)	37.85	29.84	67.19	46.20	<0.001	+29.34	47.52
Vit D (µg)	2.19	1.55	2.19	1.47	N/S	0	2.00
Vit E (mg)	5.05	2.98	3.09	1.04	<0.001	1.96	2.67
Zinc (mg)	8.45	3.73	7.40	2.26	N/S	1.05	4.14
Thiamin (mg)	1.21	0.60	1.20	0.30	N/S	0.01	0.60
Riboflavin (mg)	1.53	0.62	1.46	0.44	N/S	0.07	0.54
Folate (mg)	207.11	100.11	202.97	66.1	N/S	4.14	99.97
Vit B6 (mg)	1.62	0.53	1.71	0.66	N/S	+0.05	0.76
Vit B12 (mg)	4.63	2.63	3.93	1.29	N/S	0.70	3.31

Table 9b : *Between group differences in reported micronutient intake (absolute values)*

Apart from vitamin A at week 8 there were no significant differences in micronutrient consumption between LSD and SCD

Micronutrient	LSD n=35		SCD n=35		
	Mean	s.d	Mean	s.d	*P*
Vit A (μg)	1057.93	1159.76	544.42	292.43	<0.05

Table 9c: ***Between group differences in reported micronutrient changes from initial to week 8 intake***

Micronutrients	LSD Mean	LSD s.d	SCD Mean	SCD s.d	Difference between groups P
Calcium (mg)	205.31	324.26	99.28	311.25	N/S
Iron (mg)	2.66	5.56	1.69	5.62	N/S
Vit A (µg)	+2.19	442.63	98.25	745.70	N/S
Vit C (mg)	+6.67	48.34	+29.34	47.52	<0.05
Vit D (µg)	2.40	8.65	0	2.00	N/S
Vit E (mg)	3.70	9.24	1.96	2.67	N/S
Zinc (mg)	0.2	3.64	1.05	4.14	N/S
Thiamin (mg)	0.06	0.36	0.01	0.60	N/S
Riboflavin (mg)	0.14	1.20	0.07	0.54	N/S
Folate (mg)	33.67	109.08	4.14	99.27	N/S
Vit B6 (mg)	0.06	0.73	+0.05	0.76	N/S
Vit B12 (mg)	2.03	10.57	0.70	3.31	N/S

Table 10 ***Three Month Follow-up***

	Group A	Group B
No. of subjects weighed	19	13
No. diaries completed	7	4
No. questionnaires returned	8	4

	Group A		Group B	
	Mean	s.d	Mean	s.d
Initial weight (kg)	81.4	±13.9	84.7	±13.1
weight week 8 (kg)	79.2	±13.8	81.7	±12.7
P	<0.01		0.01	
Initial weight (kg)	81.4	±13.9	84.7	±13.1
weight week 16 (kg)	78.9	±13.8	82.3	±12.1
P	<0.01		<0.05	
Initial weight (kg)	81.4	±13.9	84.7	±13.1
Follow up weight (kg)	80.5	±14.2	83.6	±12.9
P	N/S		N/S	
Weight week 8 (kg)	79.2	±13.8	81.7	±12.7
Weight week 16 (kg)	78.9	±13.8	82.3	±12.1
P	N/S		N/S	
Weight week 16 (kg)	78.9	±13.8	82.3	±12.1
Follow up weight (kg)	80.5	±14.2	83.6	±12.9
P	<0.01		N/S	

3.5 Discussion

3.5.1 Discussion on Methodology

The return rate of food record diaries every fortnight was between 90-100%. This was because of constant reminding from the researcher, including telephone calls to check that subjects had remembered to complete them.

3.5.2 Two day records and ratio of reported energy intake to basal metabolic rate (EI:BMR)

The length of time over which the food record diaries were kept is a further point for discussion. Bingham (1982) suggests that it is the total number of days which are important to estimate change in a population group, and the number of days observed do not have to be consecutive.

Fig 9: Number of days required to classify 80% of the population into appropriate thirds of intake with 95% confidence.

	Males	***Females***
Energy	***5***	***4***
Fat	***9***	***6***
Protein	***5***	***5***
Carbohydrate	***3***	***2***
Sucrose	***2***	***3***

Bingham (1982)

It is acknowledged that the initial 2 day diaries used to measure current intake before subjects commenced the diets, were insufficient. However, the 6 days (2 days on weeks 2,4 and 8) should be indicative of nutient intake, apart from perhaps male fat intake. Figure 9 illustrates that in a free living population food choice varies. The more variation there is the greater the number of days are needed to predict with any confidence. However, subjects

were following prescribed standard weight reducing diets which should have minimum variation. Figure 2 (p52) indicates remarkably little variation within each group after week 2 for energy and nutrients. It may be that weight reducing diets decrease individual variation so that effectively there were six days worth of diaries to compare to baseline. It is postulated that extra days may not have improved the validity of the results. Thus, although 3 days, (9 over the eight week period) would have been preferred it may not necessarily have improved validity.

An EI:BMR ratio of <1.4 was probably not appropriate, particularly in view of the fact that only 2 days were used to estimate intake at baseline before individuals commenced the diets. Normal variation would mean that in any two day period there is a high probability of <1.4 being consumed. Goldberg et al (1991) suggests that all studies of human intake under natural conditions reveal a degree of day-to-day variability which makes it necessary to collect many days data in order to be certain that an accurate estimate of habitual intake has been obtained . Bingham (1988) supports this view (*see pilot study, Appendix I, section 1.5).* Measurements over a limited number of days could by chance contain data from several low intake days.

Black et al (1996) established that an EI:BMR ratio below 1.5-1.65 was regarded as too low to maintain body weight in adults engaging in light to moderate activity. The EI:BMR ratio of 1.4 used in the present study was based on earlier research by Goldberg et al (1991) who suggest that a ratio of <1.35 (as a guide for the accuracy of food records) was regarded as too low for the maintenance of body weight. Subjects mean initial EI:BMR ratio was 1.3 in both groups. If more days had been used to estimate habitual intake, this perhaps would have achieved an EI:BMR of 1.5. However, reports suggest even this may not even have been possible given the notorious problems of diet records in the obese. Bandini et al, (1990) state that reported metabolizable energy intake over a two week period was not representative of total energy expenditure (measured by Doubly Labelled Water) or energy requirements in non-obese and obese subjects.

Subjects may have actually been undereating on the 2 days when they recorded their intake and not necessarily under reporting. The latter implies dishonesty. Macdiarmid and Blundell, (1997) in a recent study on recorded food intake found that some subjects admitted altering their diet, consciously inhibiting intake because they felt guilty about recording specific amounts. Others found themselves eating less because they could not be bothered recording the items. The diaries made them more aware of what they were eating.

It was more apparent that under reporting or under eating on the days recorded may have occured during the second half of the study, as weight loss did not relate to reported intakes at week 16 (as it did between weeks 1-8). This is common in obese patients, confirming the findings of other studies (Jebb and Prentice, 1995). Because of this it is highly unlikely that weighed intakes would have been accurate and estimated record diaries would still be the method of choice. These results do, however, illustrate the great problems associated with using effective dietary assessment methods. At three month follow up, it was impossible to analyse food intake since only a small number of individuals returned the diaries (see section *3.4.10*). At this stage both groups were seen to gain weight, confirming the frequently reported difficulties in successful long term weight maintenance (Larson et al, 1995).

3.5.3 Diet Sheets and Information Booklet.

Clarity of instruction was achieved, although not formally tested, as shown in the pilot study (Appendix VI). Individuals generally had no problems in understanding what was required of them. Understanding instructions has been shown to improve compliance rates (Ley, 1989) and was, thus, extremely important in the study.

3.5.4 Sample Size

A sample size of 68 ensured that an effect size of an appropriate magnitude could potentially be identified within accepted statistical confidence limits. Distribution of initial weight between the two groups (male and female) was equal.

3.5.5 Weight Loss

Although there was a significant amount of weight loss ($p<0.001$) for subjects in Group $A_{LSD-SCD}$ and Group $B_{SCD-LSD}$ between weeks 1 and 8, there was no significant difference in weight loss induced between the two diets (Table 5a). Comparable weight loss on each diet was an important finding because it suggests that weight loss can be achieved by following a diet which contains added sucrose, at an equal rate to a more traditional diet low in added sucrose. When split into gender groups a similar pattern emerged. Both males and females on the SCD (week 8) showed highly significant weight loss, $p<0.001$ (Table 5b) compared to their initial weight. Weight loss at week 8 on the LSD, compared to baseline weight was also significant (males $p<0.01$ and females $p<0.05$) (Table 5b). However, there was no significant difference (at week 8) in weight change between each diet group when analysing gender differences and therefore, comparable data confirms that weight loss can occur by incorporating added sucrose in reducing regimes at a similar rate to low added sucrose diets.

Weight loss between weeks 9-16 was poor in both groups as a whole (Table 5a) and also when analysed in gender groups (Table 5b). Although a reduction in weight loss with the duration of the diet has previously been documented (Garrow, 1991), it is possible that the crossover design of the study may have had a negative influence over weight loss during this period (section *3.5.7*).

3.5.6 Carbohydrate and Fat

Compliance rates assessed by the amount of weight loss compared to that predicted from the diet prescriptions was similar on both diets (section *3.4.4*). Diets which encourage carbohydrate intake may have an effect on fat reduction (Shah et al, 1994, Prewitt et al, 1991 and Burkhill et al, 1995) and it has been suggested that sugar (added sucrose) alone may be the important variable in enhancing carbohydrate consumption (Bolton-Smith and Woodward, 1994, Hill and Prentice 1995 and Black,1991). Flatt, (1996) suggests that high fat diets promote fat accumulation significantly more than high carbohydrate diets. The present study did not initially set out to reduce fat, but, by encouraging higher levels of

added sucrose in the diet total carbohydrate levels rose and fat intakes on the SCD fell spontaneously, showing a significant reduction. However, maintaining such high added sucrose levels was seen to be problematic. Not all subjects were able to achieve 10% energy from added sucrose. At interview, many subjects stated that they liked the option of being able to incorporate some sweet (added sucrose containing) foods in their diet, but, despite this some were rather cautious. Negative attitudes and beliefs towards added sucrose and weight loss may impair successful inclusion of it in weight reducing diets West and de Looy, (in press) (see chapter 4).

Increasing the carbohydrate:fat ratio may be important in the short and long term because of its beneficial effect on sparing fat free mass (Lyon et al, 1995 and Lean and James, 1988). Low fat, ad libitum carbohydrate diets can lead to weight loss (Shah et al 1994, Prewitt et al 1991). Bolton-Smith and Woodward, (1996) suggest that a diet which contains a high percentage of energy from carbohydrate (both starch and sugars) may assist in weight loss if the proportion of energy from fat is low. However, the literature is conflicting. Golay et al (1996) in closely supervised in-patients and Lean et al, (1992) in free living subjects found no differences in weight loss between high and low carbohydrate diets.

Initial percentage levels from alcohol were quite high, particularly in men. This was attributed to the provision of a working mens club in the locality which was frequented straight after work. However, once the diets commenced percent energy from alcohol dropped significantly. Subjects, however, stated that they found it difficult to keep to just one unit of prescribed alcohol per day.

3.5.7 The Crossover Design

The crossover design of the study was expected to demonstrate significant differences in compliance rates between the two diets, however, unexpectedly, motivation severely decreased at switch over as indicated by weight loss. Subjects expressed anxiety at change. Whilst decreasing weight loss has been well described with duration of diet, it would seem that changing the diet characteristics may not result in enhanced motivation and weight loss.

Under reporting or under eating during the recording period (Macdiarmid and Blundell, 1997) was very apparent during the second eight weeks since there was no significant weight loss on each of the diets; although large energy deficits were recorded in the food record diaries. Under reporting is almost universal amongst obese subjects, (Jebb and Prentice, 1995). Discrepancies between weight loss and energy intake weeks 9-16 show this to be most blatant in the latter half of the study. Possible reasons for this, which were highlighted at interview, included poor motivation after the switch over period. Subjects did not lose weight but, suggeted that they felt bad about not complying. It is possible that they under reported their intake to impress the researcher. Another reason may have been carelessness in completing the food record diaries.

3.5.8 Long Term Follow-ups

Considering the 19 subjects in Group A and 13 in group B who returned for a three month follow-up after the diets had finished, it appears that equal amounts of weight loss occured between weeks 1-8 and 9-16 on both diets. It is very difficult to draw any conclusions from this but, diets containing added sucrose can apparently compete with low added sucrose diets and achieve comparable amounts of weight loss.

However, difficulties in maintaining weight were clear between weeks 16 and follow up. Both groups gained weight, confirming the frequently reported difficulties in successful long term weight loss maintenance (Larson, 1995). Each diet group, however, did not return to their mean initial weight. Since a large number of the food record diaries for the follow-up period were not returned, low numbers meant that analysis of these would not have produced any meaningful results. Therefore, no comments can be made regarding the influence of the diet on weight gain at the three monthly follow-up.

3.5.9 Micronutrient Composition

There has been much conflicting evidence on the diluting effects of micronutrients in diets with a high proportion of added sucrose in them (see section *1.3.1*). The present study

looked at absolute micronutrient values for each diet between baseline and week 8 (Table 9a). Data suggested that subjects on the LSD met Estimated Average Requirements (EAR's) for calcium, but not Recommended Nutrient Intakes's (RNI's) Those subjects on the SCD however, did meet RNI's. There was seen to be a significant reduction between initial calcium levels and those at week 8 for subjects on the LSD. However, there was no such difference for subjects on the SCD. This may have been due to the inclusion of low fat, yoghurts containing added sucrose in this diet. The main sources of calcium were seen to come from the milk allowance - cheese, yoghurts and dairy foods.

Recent figures from the National Food Survey (1993) indicate that the iron content of food obtained for consumption at home in 1993 averaged at 9.9mg/person /d which are similar to the levels found in the weight reducing diets. Possible reasons for reductions in iron intake include an overall reduction in protein rich foods especially red meat. However, it is interesting to observe that there was not a significant difference in iron consumption at week 8 on the SCD, and this may have been because more chocolate was included in this diet, and other iron rich foods. This needs to be confirmed.

Vitamin E intake dropped by almost half in both groups. This was assumed to be related to the reduction in fat and fat containing foods at week 8.

Possible reasons for a higher amount of vitamin A on the LSD, may be because of an increased intake of fruit and vegetables in the diet. Also it was noted that several people on this diet had a higher intake of offal.

Micronutrient intake expressed per mg/MJ indicated that there were no micronutrient deficiencies in the data at week 8. Any reductions were expected due to an overall reduction in energy intake and it appears that any decrease in micronutrient status is linked more with total energy intake than added sucrose intake. Apart from vitamin A, there were no significant differences in micronutrient intake between the LSD and the SCD at week 8, (per mg/MJ).

It seems unlikely that micronutrient dilution was a consequence of the higher added sucrose diet. It is interesting to note that vitamin C actually increased in both groups (also reflected in absolute values) between initial intake and week 8 . This may have been attributed to an increased intake of fruit, fresh fruit juice and vegetables in both groups. More vitamin C would have been expected in Group A because more fresh fruit was allowed on this diet, but, the higher level was actually found in Group B. Sugar containing drinks which were allowed on the SCD such as blackcurrent cordial, (often fortified with extra vitamin C) may have contributed to this.

It is recognised that two day weekly records would probably not reflect micronutrient intake accurately and in further studies more days would be required, but this was out with the scope of this study.

The present study supported the view that micronutrient composition was not compromised by an intake of 10% energy as compared to 5% energy as added sucrose in weight reducing regimes, despite a low energy intake.

3.6 Conclusion

Weight loss can be achieved by prescribing a commercially added sucrose (10% E) containing diet at a similar rate to an isoenergetic diet which is lower (5% E) in commercially added sucrose. Encouraging foods containing added sucrose as part of the energy allowance may be beneficial in promoting lower fat consumption. There may, therefore, be advantages in permiting added sucrose in weight reducing diets for those who like it. Micronutrient intake was found to be adequate in both diets. The practice of banning added sucrose as part of low energy diets is, thus, not supported.

4.0 CHAPTER FOUR

The Attitudes and Beliefs of Subjects on the LSD and SCD

4.1 Method

4.1.1 Questionnaire Design

Using the Ajzen and Fishbein (1980) protocol for questionnaire construction, a pilot study was undertaken to elicit the main factors identified as 'dieting behaviour', and questions in the questionnaire were based around these.

4.1.2 Attitudes and Beliefs

Attitudes and beliefs concerning weight loss, dieting and the nutrient composition of weight reducing diets were assessed with respect to the variables specified within the model of the Theory of Planned Behaviour (T.P.B) (Ajzen, 1988). Subjects were given questionnaires at the beginning and end of each dieting period:

- before commencing the diets (Q0).
- at week 8 (Q8).
- at week 16 (Q16).

4.1.3 Procedure

1. By interviewing subjects from a pilot study the main items which subjects believed would affect dieting outcome, were identified:

- following the weight reducing diet very carefully.....
- losing weight.....
- reduction of fried/fatty foods.....
- reducing sugar* in food and drink.....
- reducing sweet* foods.....
- avoiding snacking in-between meals.....

---

* *'Sugar' in the questionnaire refers to commercially added extrinsic sucrose.*
* *'Sweet foods' in the questionnaire refers to those containing commercially added extrinsic sucrose.*

Subjects were made aware of these definitions before completing the questionnaires.

2. A questionnaire was constructed using a line scale in which each item was posed for each component of the TPB (Ajzen, 1988). That is, intention, attitude, subjective norm and perceived control (Fig. 3). In the model of the TPB (Ajzen, 1988), these are known as components affecting behaviour. Subjects marked a scale between 0-10 (0 was the most negative and 10 the most positive response).

3. Thus, each item was questioned with respect to each component (see Fig. 3 and Appendix IX).

The reliability of the questionnaire was determined with a measure of internal consistency, Cronbach's alpha. This analysis was conducted using SPSS for Windows. The reliability was 0.80. The validity of the instrument was addressed by following the procedures for questionnaire construction using the Ajzen and Fishbein (1980) protocol.

Fig. 3. ***Examples of Questions from the Questionnaire.***

Intention

I intend to follow the weight reducing diet very carefully:

definitely do----------definitely do not

Attitude

My attitude towards following the weight reducing diet very carefully is:

extremely----------extremely favourable unfavourable

Subjective Norm

Most people who are important to me think I should follow the weight reducing diet very carefully:'

disagree----------agree

Perceived Control

For me to follow a weight reducing diet carefully will be:

difficult----------easy.

A series of questions as seen in Fig.3. were developed, one for each item from a component perspective, thus there were 6 items by 4 components = 24 questions.

Individual questions from the questionnaire were related to outcome behaviour at week 8.

4.2 Data Analysis

4.2.1 Nutritional

Methods of analysing nutrient intake have been reported earlier (section *3.3*). The Student's t-test using SPSS for Windows was used to measure any differences in weight loss and for the analysis of fortnightly nutrient intakes of energy, fat, carbohydrate and added sucrose on both the LSD and the SCD.

4.2.2 Attitudes and Beliefs

Values were obtained for questions about the various items, which were set in the context of different components. Multiple Regression was used to identify the relationship between components and behavioural outcome measures, which included weight loss and added sucrose consumption. The relationship between these outcomes and the components, intention (I), attitudes (A), subjective norm (SN) and perceived control (PC) were explored for each selected item or question.

Analysis of variance was used to measure any changes in responses to the questionnaire between Q0, Q8 and Q16.

4.3 Results

4.3.1. Weight Loss

As reported earlier (section *3.5.5*), weight loss occurred on both diets between weeks 1-8. Subjects on the LSD lost 2.2kg and on the SCD 3.0kg, although there was no significant difference in weight loss between the two groups.

4.3.2 Macronutrients

Initial percentages of energy from fat, carbohydrate and added sucrose were not significantly different between each group (section *3.5.6*). At week 8 in Group B there was no significant difference in percentage energy from added sucrose, from baseline, but there was a significant decrease in percentage energy from fat $p<0.05$. This was not observed in LSD. SCD showed a significant rise in total carbohydrate $p<0.001$ supporting the carbohydrate:fat 'seesaw' theory (McColl, 1988).

4.3.3 Predictors at Q0 of Behavioural Outcome at Q8

i) Weight Loss

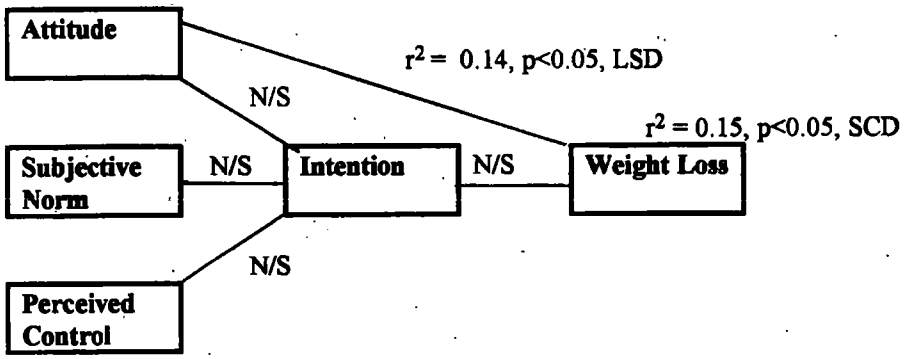
The results from the attitudes and beliefs questionnaire showed that both the groups had positive attitudes (high scores) towards complying with the various dieting behaviours, elicited in the pilot (section *4.1.3*). The main predictor at Q0 of weight loss at week 8 was attitude towards avoiding sugar on food and in drinks. A positive attitude towards this behaviour at Q0 was seen to correlate with weight loss on both the LSD and the SCD ($r^2=0.14$, LSD $p<0.05$, $r^2=0.15$, SCD $p<0.05$) (Fig. 4).

ii) Sucrose Consumption

Positive attitudes at Q0 on the SCD towards reducing fat in the diet were highly predictive of added sucrose consumption at week 8 ($r^2=0.50$, $p<0.001$) (Fig. 5a). Although intention and attitudes to exclude added sucrose from the diet were positive, behaviour showed that SCD individuals were actually including it in their diets because they had

Fig 4

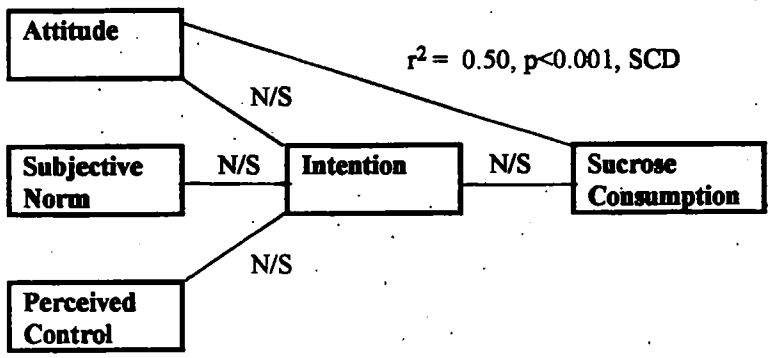
Predictors at Q0 of weight loss at week 8



"My attitude towards avoiding sugar on food or in drinks is":

Fig 5a

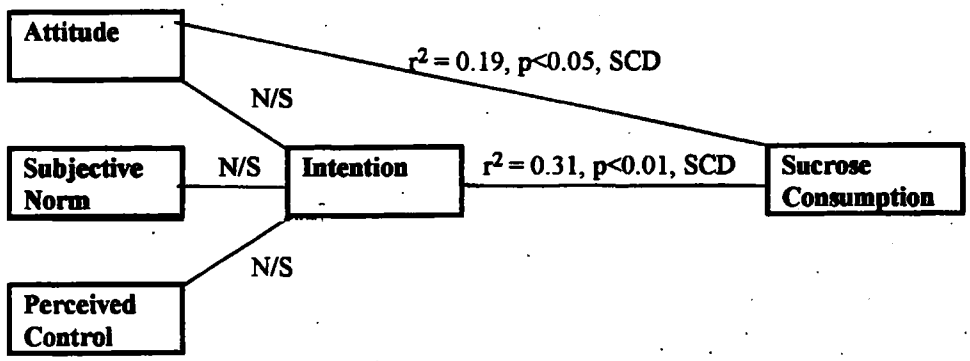
Predictors at Q0 of added sucrose consumption at week 8.



"My attitude towards eating fried/fatty foods less often is":

Fig 5b

Predictors at Q0 of added sucrose consumption at week 8.



"My intention/ attitude towards avoiding sugar in food or in drinks is":

NB The text below each diagram indicates the question which had a response that correlated with the Multiple Regression equation.

been prescribed it. Nevertheless these negative views towards sugar correlated with added sucrose consumption (Fig 5b). This attitude pattern was maintained at week 8 (Fig 7c). Finally, positive attitudes at Q0 towards reducing snacks in-between meals was correlated with added sucrose consumption at week 8 (r^2=0.25, $p<0.01$) (Fig. 5c) on the SCD.

4.3.4 Correlations between Components and Behavioural Outcome at Q8.

i) Weight Loss

At week 8 weight loss was seen to correlate (r^2=0.30, $p<0.01$) with fat intake on the SCD but this was not observed on the LSD. Also weight loss was correlated on the SCD with positive attitudes towards reducing fried fatty foods in the diet (r^2=0.16, $p<0.05$) (Fig. 6a) and with reducing sugar on food and drinks (r^2=0.16, $p<0.05$) (Fig. 6b). Perceived control responses showed that subjects maintained that it would be easy to lose weight on the SCD diet (r^2=0.30, $p<0.01$) (Fig. 6c), but felt that it would be less easy to control their added sucrose consumption (r^2=0.23, $p<0.01$) (Fig. 6b) than they had anticipated at Q0.

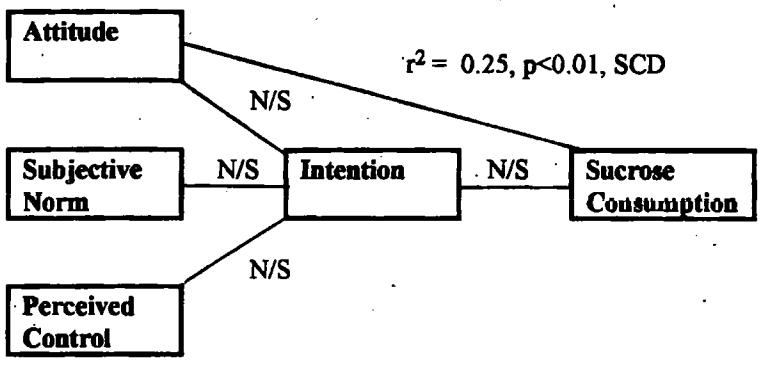
Ii) Added Sucrose Consumption

Positive attitudes towards weight loss at Q8 on the SCD correlated well with increased added sucrose consumption. Added sucrose intake at week 8 correlated with strong attitudes to 'lose weight' (r^2=0.50, $p<0.001$, SCD) (Fig. 7a). Positive attitudes at week 8 (SCD) towards reducing fat and fried fatty foods in the diet correlated well with added sucrose intake week 8 (r^2=0.35, $p<0.01$) (Fig. 7b). Also positive attitudes at week 8 about reducing sugar in food and drinks (r^2=0.11, $p<0.05$) (Fig. 7c), sweet foods (r^2=0.15, $p<0.05$), (Fig. 7d) and snacking in-between meals (r^2=0.15, $p<0.05$) (Fig. 7e) correlated with the higher added sucrose consumption on the SCD. These responses were not observed on the LSD.

Although there were negative views on the incorporation of added sucrose in the SCD, subjects maintained added sucrose intake at a level habitual to them.

Fig 5c

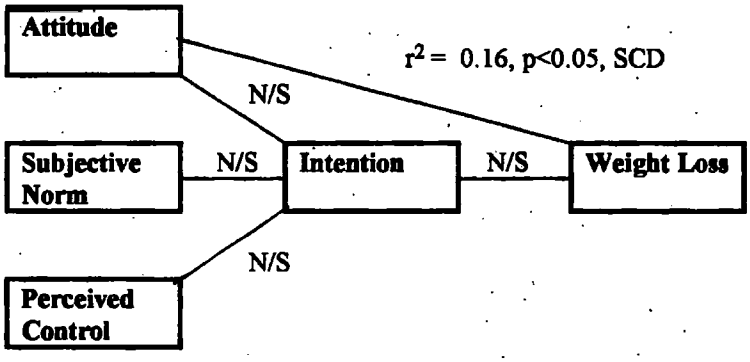
Predictors at Q0 of added sucrose consumption at week 8.



"My attitude towards avoiding snacks in-between meals is":

Fig 6a

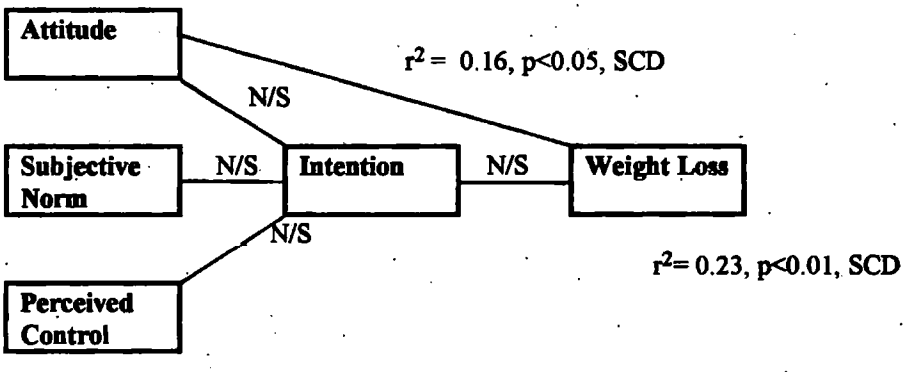
Correlations between components and weight loss at week 8.



"My attitude towards eating fried/fatty foods less often is":

Fig 6b.

Correlations between components and weight loss at week 8.

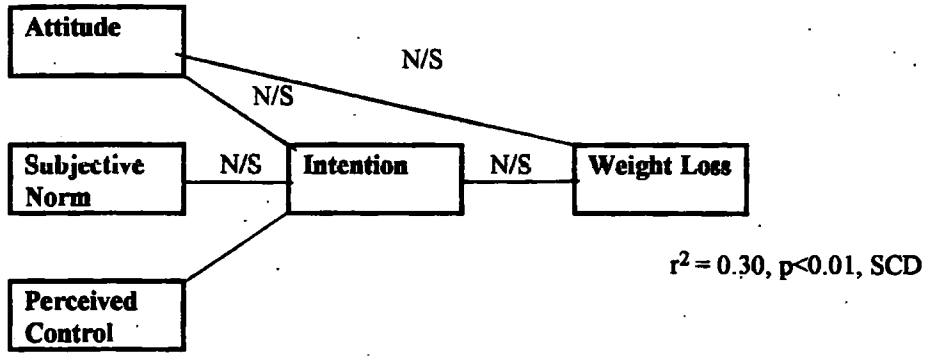


"My attitude towards avoiding sugar on food and drink is":
"For me controlling my intake of sugar on food and in drinks .....will be.":

NB The text below each diagram indicates the question which had a response which correlated with the Multiple Regression equation.

Fig 6c

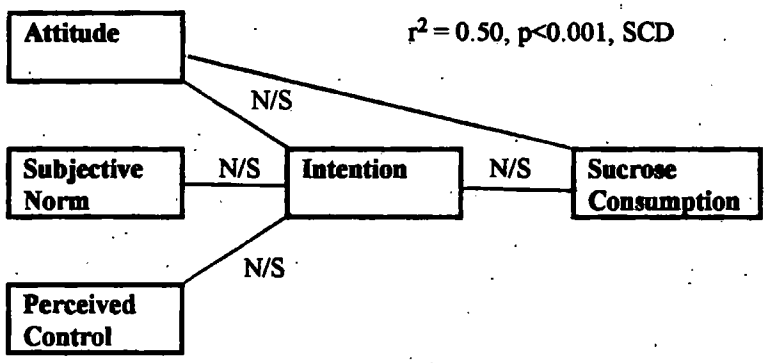
Correlations between components and weight loss at week 8.



"For me to achieve weight loss on a weight reducing diet will be":

Fig 7a

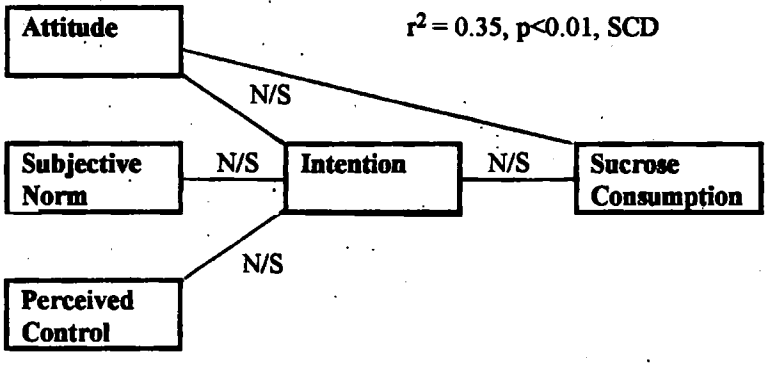
Correlations between components and added sucrose consumption week 8.



"My attitude towards losing weight is":

Fig 7b

Correlations between components and added sucrose consumption week 8.



"My attitude towards eating fried/fatty foods less often is":

NB The text below each diagram indicates the question which had a response which correlated with the Multiple Regression equation.

Those on the LSD, however, significantly reduced their percentage energy derived from added sucrose as expected.

Perceived Control on the SCD showed that subjects had more positive views about being able to control their intake of sweet foods, (r^2=0.21, $p<0.05$) (Fig. 7c) than at baseline, this correlated with increasing sucrose consumption.

4.3.5 Predictors at Q8 of Behavioural Outcome at Q16.

i) Weight Loss.

Weight loss on both diets between weeks 9-16 was poor with a mean weight loss in Group $A_{LSD-SCD}$ of 0.4kg and in Group $B_{SCD-LSD}$ +0.09kg. Those subjects who experienced the SCD between weeks 1-8 and who were about to commence the LSD gave less favourable responses towards controlling their sugar intake than they had at Q0 and this correlated with weight loss at week 16 (r^2= 0.19, $p<0.05$), (Fig.8a). Intention to omit sweet foods in group $B_{SCD-LSD}$ was less strong before commencing the LSD for the final eight weeks compared to Q0 and this was predictive of weight loss at week 16 (Fig. 8b).

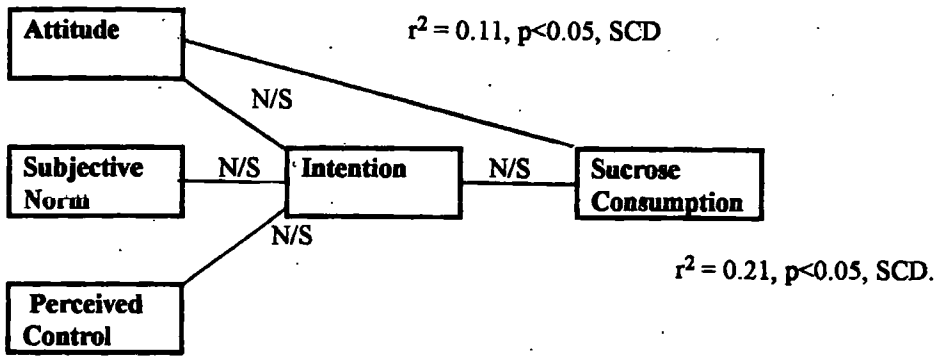
4.3.6 Correlations between components and weight loss at Q16.

i) Weight Loss.

Correlations were only observed for those subjects who had switched from the SCD to the LSD at week 8. Attitudes towards following the weight reducing diet very carefully, which were very high at Q0 had significantly dropped by Q16, after experiencing the LSD ($p<0.01$). This correlated with poor weight loss at week 16, r^2=0.12, $p<0.05$, (Fig.9a). Similarly intentions to follow the weight reducing diet were also less positive at Q16 and again these correlated with weight loss (r^2 = 0.37, $p<0.001$) (Fig. 9b).

Fig 7c

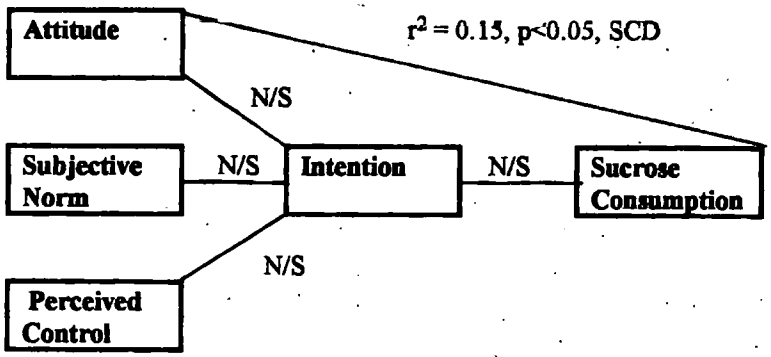
Correlations between components and added sucrose consumption week 8.



"My attitude towards avoiding sugar on food and drinks is":
"For me controlling my intake of sugar on food and in drinks .....will be":

Fig 7d:

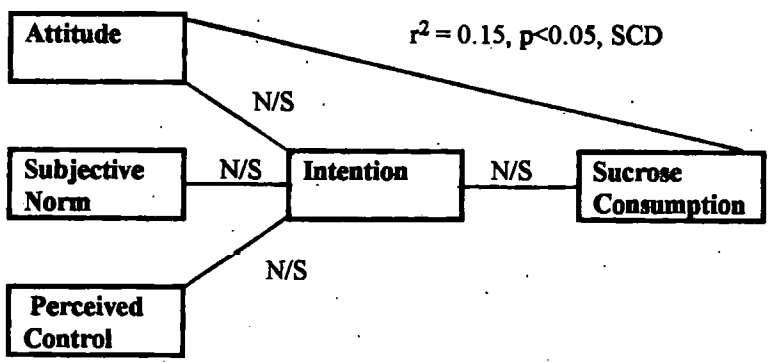
Correlations between components and added sucrose consumption week 8.



"My attitude towards omitting sweet foods from my diet is":

Fig 7e:

Correlations between components and added sucrose consumption week 8.

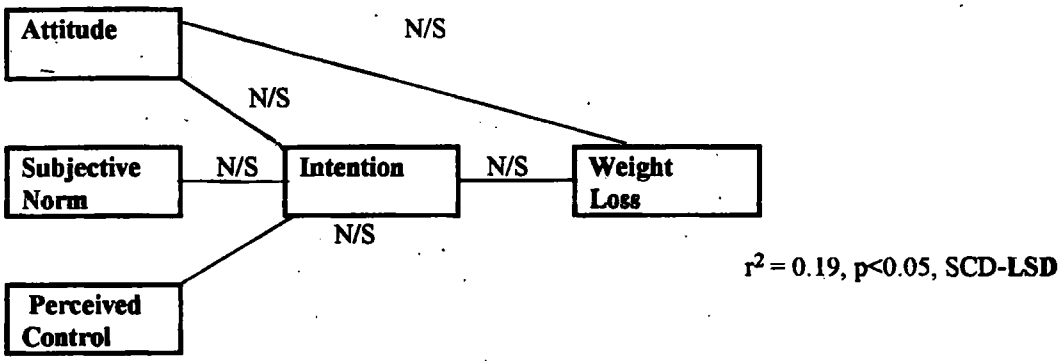


"My attitude towards avoiding snacking in-between meals is":

NB The text below each diagram indicates the question which had a response which correlated with the Multiple Regression equation.

Fig 8a:

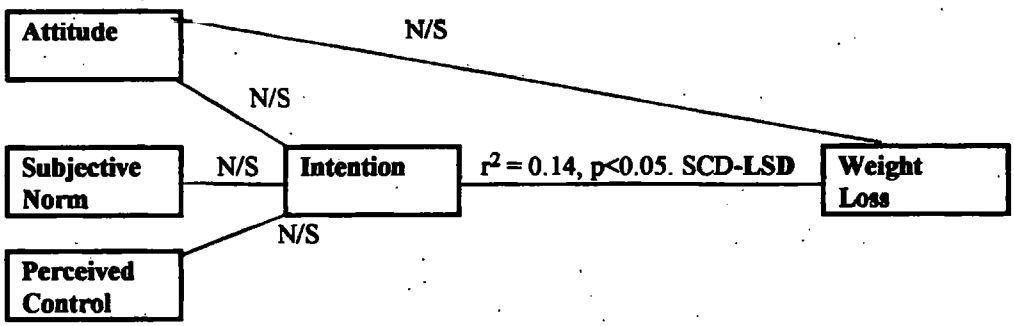
Predictors at Q8 of weight loss at week 16.



"For me controlling my intake of sugar on food and in drinks.....will be":

Fig 8b:

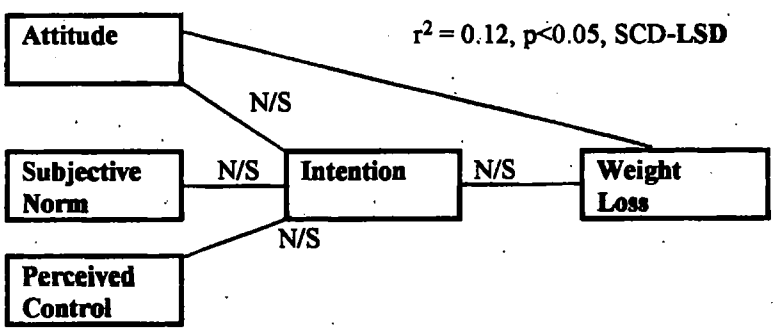
Predictors at Q8 of weight loss at week 16.



"I intend to omit sweet foods from my diet":

Fig 9a:

Correlations between components and weight loss week 16.

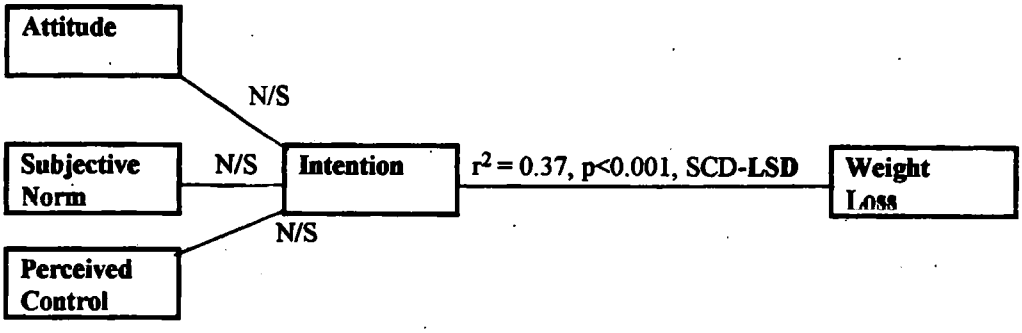


"My attitude towards following the weight reducing diet very carefully is":

NB The text below each diagram indicates the question which had a response which correlated with the Multiple Regression equation.

Fig 9b:

Correlations between components and weight loss week 16.



"I intend to follow the weight reducing diet very carefully :

NB The text below each diagram indicates the question which had a response which correlated with the Multiple Regression equation.

ii) Added sucrose consumption

Predictors and correlations of added sucrose consumption at week 16 were not calculated because the under reporting or under eating (on the days recorded) of nutrients between weeks 9-16 meant that this data could not be put to any meaningful use.

4.3.7 Mean Score for Items using Analysis of Variance

Subjects who commenced the LSD at Q0 initially had very positive attitudes towards losing weight (score = 8.4). However, these significantly dropped by week 8 (score = 7.0, $p<0.05$), after experiencing the LSD. At week 16, after eight weeks on the SCD scores were seen to increase again (7.6, $p<0.05$).

Significant differences were seen in scores, at Q0, Q8 and Q16 for the subjective norm question which considered whether salient others thought that subjects should go on a weight reducing diet or not. Scores significantly increased between the different time periods on both diets suggesting that the subjects friends and family thought that they should be dieting more, even at the end of the total dieting period.

Subjects who had just experienced the SCD between Q0 and Q8 had a significantly more positive response (for perceived control, $p<0.01$) at Q8 towards following weight reducing diet very carefully indicating that they found it easier to follow the diet than they anticipated at Q0. This important trend started to reverse again at Q16 after experiencing the LSD.

4.4 Discussion

4.4.1 Synopsis of Weight Loss and Macronutrient Status.

Although there was a significant amount of weight loss ($p<0.001$) on the LSD and the SCD between weeks 1 and 8, there was no significant difference in weight loss induced between the two diets. This suggests that weight loss can be achieved by following a diet containing added sucrose, at an equal rate to a more traditional low in added sucrose diet (McCreery, 1991, Westenhoefer, 1993).

Carbohydrate has been suggested to be more satiating than fat (Blundell et al, 1994) and this may result in greater compliance, and hence weight loss. It has been suggested that sugar (added sucrose) alone may be the important variable in enhancing carbohydrate consumption (Bolton-Smith and Woodward, 1994). It has been postulated that diets high in fat are more likely to result in body fat accumulation (Hill and Prentice,1995). Thus, promoting a diet that is low in fat and high in carbohydrate may be beneficial for those who are trying to lose weight. However, maintaining a significant high added sucrose level was seen to prove problematic. Not all subjects achieved 10% of their energy from added sucrose although, all subjects maintained a significantly greater intake than those on the LSD ($p<0.001$). Attitudes and beliefs towards added sucrose in weight reducing diets may normally prohibit successful inclusion of it as shown by the high scores in attitudinal measures, both at week 0 and week 8, to reduce sugar in food and drinks and to omit sweet foods from the diet. Positive views on these behaviours correlated negatively with the higher added sucrose intake on the SCD. Individuals wanted to reduce added sucrose but were made to include it because of the dietary prescription, which contradicted their attitude towards it.

4.4.2 Attitudes and Beliefs

The results from the attitudes and beliefs questionnaire showed both groups to have positive intentions and attitudes towards complying with the various dieting behaviours to

ensure weight loss. However, contrary to predictors of the Ajzen and Fishbein model (1980), and other workers who use the model in weight loss studies (Saltzer, 1980, Schifter and Ajzen, 1985) intention was not seen to be a major predictor of weight loss. Nor did attitude, subjective norm, or perceived control to 'lose weight', 'avoid sugar in food and drink' and 'reduce fried fatty foods' predict intention. Conversely, attitudes were seen to be highly predictive of weight loss, although Schifter and Ajzen (1985) found no such relationship in their study of college women.

In the present study of volunteers following the weight reducing programme, subjective norm did not appear to play a predictive role, in agreement with Schifter and Ajzen (1985), but contrary to the work of Saltzer (1980). However, in the latter study the referrals were all medical and therefore, the study group had a very much heightened awareness of their need to lose weight for medical reasons which may have influenced subjective norm. Schifter and Ajzen (1985) showed consensus with the present study in that perceived control had some affect on weight loss in young college volunteers.

Unlike Schifter and Ajzen (1985) and Saltzer (1980) the present study asked individuals to devise their own dieting behaviour items. This study therefore, was able to investigate more closely what obese individuals actually thought about their own 'controlled' weight loss.

4.4.3 Added sucrose Inclusion and Weight loss

Throughout the study there were negative attitudes about incorporating added sucrose in weight reducing diets. The main predictors on both diets at Q0 of weight loss at week 8 were positive attitudes towards reducing sugar in food and drinks suggesting that negative preconceptions about it's incorporation in weight reducing diets related to weight loss. This highlights negative preconceived views about the inclusion of sweet foods in weight reducing diets. It appears that subjects had strong views that foods containing added

sucrose should be forbidden in weight reducing diets, in a similar way that Thomas (1981) suggested that starchy foods may be avoided if individuals believed that they promoted obesity.

4.4.4 Added Sucrose as an Indicator of Success

Throughout the study subjects maintained positive attitudes towards the avoidance of added sucrose as either foods containing it, snacks or added to food and drinks. However, SCD were persuaded to maintain a higher level (relative to the LSD), of these foods which were similar to their habitual intake despite their recorded concerns. Attitudes were not however, correlated with behaviour in this respect on the SCD which demonstrates an inconsistency with the predictors in the TPB model as used in this study. Weight loss was at a similar rate to LSD.

Throughout the study there were positive attitudes to reducing fried/fatty foods on both of the diets. Only those on the SCD, however, had a significant drop in percentage energy from fat compared with baseline intake. Questions on attitudes at week 8, towards eating fried/fatty foods less often, correlated with added sucrose intake on the SCD, but not on the LSD. It may be that the ability to more freely manipulate carbohydrate using added sucrose was available to those on the SCD and this resulted in a lowered fat consumption. This would be consistent with the work of Davies and Baghurst, (1992) although this work was not with the obese. It is possible that the LSD could not reduce their fat intake because they had less permitted added sucrose in their diet.

At week 8 weight loss was highly correlated with fat consumption on the SCD. This supports recent findings which advocate low fat, high carbohydrate weight reducing diets (Shah et al, 1994). On the LSD no correlation between fat intake and weight loss was found. Diets which encourage carbohydrate may reduce fat consumption (Burkill et al, 1995). Specifically an increased intake of added sugar rather than that of complex

carbohydrate tends to dilute fat energy (Hill and Prentice, 1995). As fat may influence appetite (Blundell et al, 1994) reducing fat could play a role in compliance.

Negative attitudes, however, still persisted for subjects on the SCD at week 8, when asked direct questions regarding added sucrose. This was despite successful weight loss and a reduction in fat consumption on this diet. Positive attitudes towards avoiding added sugar on food and drink and sweet foods seem to be an ingrained prerequisite to dieting and even though weight reducers are successful on diets that contain these foods.

However, subjects after experiencing the SCD between weeks 1-8, had positive views over their perceived control at week 8 to 'lose weight'. They maintained strong beliefs in their capacity to adhere to this diet. This was not observed on the LSD and may indicate enhanced compliance with diets containing added sucrose.

Contrary to the predictors of Ajzen and Fishbein's model (1980), intention was not seen to be the most predictive of outcome behaviour, but rather attitude towards behaviour seemed to be the main predictive component in this study.

4.4.5 Weight Loss at Week 16

Weight loss between weeks 9-16 was poor. Subjects who had initially experienced weight loss on the SCD between weeks 1-8, and then switched to the LSD seemed to be less inclined (as shown by intention and perceived control, Fig. 8a and 8b) to control their sugar/sweet food intake over the second eight weeks. This correlated with poor weight loss at week 16. If these subjects were reticent to have a tight control over their added sucrose consumption (perhaps due to their experience of including it in their diet and losing weight during the first eight weeks) then they may have continued to include added sucrose on the LSD, in addition to their increased starch intake on this alternate diet. Therefore, poor weight loss would have been inevitable. Indeed some subjects who were originally on

the LSD struggled to maintain such a low prescription (<5%). It is postulated that subjects who were used to added sucrose in their reducing diets would have been less ready to give it up. Since under reporting occurred between weeks 9-16, however, it is difficult to confirm this theory.

Individuals who had switched from the SCD to the LSD had significantly less favourable attitudes and intentions towards following the diet at week 16 ($p<0.01$). This may have had an impact on poor weight lost at this point. Such unfavourable views which were not noted on the SCD between weeks 9-16 may have been because subjects found it difficult to comply with the more restrictive diet after accustoming themselves to the SCD for the first eight weeks.

Those subjects who were on the SCD for the first 8 weeks were seen to perceive it to be easier to follow the weight reducing diet more carefully, than they did at Q16 after experiencing the LSD. This may be because they were able to achieve greater compliance on the SCD.

4.4.6 Change in Mean Score between Q0, Q8 and Q16.

The significant changes in score which were observed using analysis of variance indicated that motivation to lose weight on the LSD decreased after experiencing the diet at week 8, but was seen to increase again by week 16 after following the SCD, suggesting that, subjects may have found it easier to follow the latter, and as such were spurred on. Similarly, less favourable attitudes were seen in group B, towards following the weight reducing diet, but only after experiencing the LSD weeks 9-16. This may imply a lower preference for this diet compared to the added sucrose one. This is also supported by perceived control results, whereby, subjects in the Group $B_{SCD-LSD}$, perceived it to be easier to follow the diet (at week 8), but found it less easy at week 16, after switching to the LSD. At week 16, scores for subjective norm were significantly higher on both diets,

suggesting that salient others had more intense views that the subjects should go on a weight reducing diet. This may be because poor weight loss occurred between weeks 9-16.

4.4.7 Conclusion

In conclusion, weight loss can occur on a weight reducing diet which contains added sucrose. However, pre-existing negative attitudes towards the inclusion of foods containing added sucrose, could create barriers to compliance, using an approach that recommends it. Subjects wanted to reduce added sucrose, but those on the SCD were made to include it because of the dietary prescription. Subjects on the SCD significantly reduced their fat intake when foods containing added sucrose were included in their dietary prescription compared to those in the LSD group. A strong correlation was seen between fat intake and weight loss on the SCD but not on the LSD. Negative attitudes and beliefs regarding added sucrose might usefully be addressed before the practitioner can implement dietary intervention using this strategy.

5.0 CHAPTER FIVE

Feed back from occupational health personnel and management.

A questionnaire was given to the management and occupational health nurse in order to determine their thoughts on the 16 week weight reducing programme and whether such interventions were seen to have a place in the work environment (Appendix XI). They were asked to outline the main benefits of the study to the work force. Both the management and the occupational health nurse said that the programme helped to boost morale since staff felt that management cared enough to bring in a health specialist. General opinion was that many workers were at risk of health problems associated with obesity, including heart disease and back problems. They suggested that the advantages of addressing overweight and obesity may prevent many associated illnesses and benefit the company by promoting good levels of health and avoiding days lost through absenteeism

It was also agreed that individuals who took part in the study had much more of an incentive to comply with the weight reduction programme because they participated with their work mates. The nurse said that this was definitely the case because of peer encouragement, or possibly because they were 'captive' within the institution, as opposed to losing weight in isolation on self imposed diets.

Management were asked if they felt that enough attention was given to health promotion and healthy eating within the company. Although a 'healthy heart' campaign had been run in the occupational health department, it was thought that there was room for improvement in the health promotion forum. Management suggested that a more lively interesting campaign which communicated the message of healthy eating was needed other than the usual 'boring' posters pinned up in the canteen. As such they welcomed the 16 week weight reducing programme and suggested that they would support it as a permanent feature within the company.

The occupational health nurse suggested that she would appreciate the opportunity to work more closely with the research dietitian and the dietetics and nutrition department at Q.M.C. She also felt that the study strengthened links between the company and outside academic institutions keeping it in touch with new research.

6.0 CHAPTER SIX

Taste

6.1 Introduction.

Taste is seen to play a substantial role in determining food selection (Shepherd, 1990) and as such, is of great significance to this study. Some research suggests that obese subjects have an increased preference for sugar containing foods, causing overindulgence when faced with such foods (Wurtman, 1981). However, others refute the obese 'sweet tooth' theory (Booth, 1987 and Drewnowski, 1991). Further, there are indications that preferences for sugar alter with shifts in body mass index and after experiencing energy deficit in sustained dieting (Cabanac and Ducleaux, 1970), whilst other research suggests this is not the case (Drewnowski, 1991). These theories have considerable implications for the present study and will be investigated further.

It is, however, acknowledged that the design and the interpretation of the results in this part of the study have limitations. The preference rating of simple sugar (added sucrose) solutions that has been used to address the 'sweet tooth' theory has questionable relevance for preferences for foods in every day life (Booth et al, 1987). Nevertheless, some studies have been able to correlate preferences for added sucrose solutions and preferences for 'every day' foods (Olson and Gemmil, 1981, and Pangborn and Giovanni, 1984). Such studies measure both hedonic responses to sugar based solutions and sweet foods. Because of the other demands on the researcher and the subjects, and because taste was not a major consideration in the present study, insufficient time was available to develop and refine the method used further. Thus, only preferences for added sucrose solutions were tested. However, since, habitual intake of sweet foods and drinks is likely to induce a liking for sweet foods, especially in between meals (Booth et al, 1987), valid analysis was undertaken between the taste preferences of subjects on the low sucrose diet and the sucrose containing diet to see if subjects started to prefer sweeter or less sweet solutions after being exposed to the two diets for eight week periods. Also observations were made

on changes in sweet preference after subjects experienced shifts in body weight and energy deficits on the weight reducing diets. It is not possible to draw any conclusions about the taste preferences of overweight subjects compared to thinner individuals because there was no control group of normal weight people. The author recognises the shortcomings of this part of the study, but this chapter aims to highlight taste as a significant factor in food choice and it's impact on compliance to weight reducing diets, and acknowledges that more in-depth research into the effects of diets containing added sucrose on sweet preferences is warranted.

6.2 Method

Taste preference tests were carried out before the programme began, at week 8 (switch over) and at week 16. The test itself required the assessment of the subjects degree of liking for a range of lime flavoured solutions which contained either 2%, 4% or 6% of added sucrose. The drinks were prepared using 20ml PLJ unsweetened lime cordial, and made up to 100ml solution with 80ml tap-water from the Edinburgh main supply. White sugar was added to the 100ml lime flavoured liquid providing 2%, 4% and 6% caster sugar. Lime drinks were presented as 30ml portions in small plastic cups. Each assessor received the samples in the same order as the other subjects, beginning with the 4% solution, then the 6% solution and finally the 2% solution. Only three samples were given to each assessor because this has been shown to give virtually as accurate results as testing with larger numbers of samples (Conner et al, 1986). A 1-7 point scale ranging from extreme approval to disapproval was used (Appendix X). The overall impression and preference was assessed this way. No assessor indicated any difficulty in using this response format.

Subjects tasted each of the three samples and using the scale system they indicated their preference by ticking the point which best described their opinion of the solution (Appendix X).

6.3 Results

Table 11: ***Mean percentages of preferred added sucrose solutions between weeks 0-8, 9-16 and 1-16.***

	Group A $_{\text{LSD 1-8, SCD 9-16}}$			**Group B** $_{\text{SCD 1-8, LSD 9-16}}$			
	Mean %	**s.d.**	**Median %**	**Mean %**	**s.d.**	**Median %**	***P***
Taste 1	4.9	± 0.9	6	4.3	± 2.0	4	N/S
Taste 2	4.5	± 1.0	4	4.2	± 1.0	4	N/S
P	N/S			N/S			
Taste 2	4.5	± 1.0	4	4.2	± 1.0	4	N/S
Taste 3	4.3	± 2.0	4	4.1	± 2.0	4	N/S
P	N/S			N/S			
Taste 1	4.9	± 0.9	6	4.3	± 2.0	4	N/S
Taste 3	4.3	± 2.0	4	4.1	± 2.0	4	N/S
P	N/S			N/S			

The results of the taste preference tests were analysed using paired t-tests between Taste 1 and Taste 2 (week 0 and week 8), Taste 2 and Taste 3 (week 8 and week 16),and Taste 1 and Taste 3 (week 0 and week 16).

6.4 Discussion

It has long been argued that over indulgence in foods containing added sucrose is a major contributor to obesity. There is a popular belief that sugar is uniquely fattening and that over consumption of sugary desserts and drinks has been central to the aetiology of obesity, heart disease and diabetes (Yudkin, 1966). There is much existing data from survey, clinical and laboratory studies (COMA- Dietary Sugars and Human Diseases, 1989) which appears to be insufficient to support the link between excessive sugar (added sucrose) consumption and obesity. Booth et al, (1987) suggest that there is no solid empirical support for the obese 'sweet tooth' theory.

The means shown in the present study for added sucrose preference show that subjects on both diets did not choose the sweetest solutions (6%) but, went for the medium strength sucrose solution (4%). Some studies indicate that the obese are sensitive to added sucrose and it has been argued that this may cause them to over indulge in sugary foods and promote weight gain (Yudkin, 1973). Subjects in this study, however, did not make the sweetest choice and did not appear to significantly change their preference for added sucrose solutions even after experiencing both of the diets. This suggests that exposure to low sucrose and sucrose containing diets did not seem to influence any change in sweet taste preference, challenging previous work (Wurtman et al, 1981).

Other research suggests that body composition (Rodin et al, 1976) and energy manipulation may influence sucrose preference (Cabanac and Ducleaux, 1970). The results of this present study showed no change in preference at week 0, 8 and 16. This was despite deficits of over 800 kcal. This may indicate that dietary changes which limit and include added sucrose do not influence sucrose preference, unlike fat where studies suggest that preferences for fat may be elevated when subjects consume a high fat diet and lowered when fat intake decreases (Mattes, 1993). It is not possible to imply that exposure to

either the LSD or the SCD between the different time periods were able to promote any changes in added sucrose liking. First of all the study proper indicated that not all of those subjects who were prescribed 10% energy from added sucrose on the SCD, were able to comply with this amount, illustrating a certain degree of control and non-compliance with dietary instructions. Secondly, preferences amongst those exposed to the SCD did not increase to 6% showing that obese subjects did not necessarily like the most sweet solution even after they had prolonged experience of added sucrose in their diets. Some studies suggest that the perception of sweetness intensity is not affected by short term caloric restriction such as overnight fasting (Drewnowski and Greenwood, 1983).

There are implications that sensory perception of sweet stimuli may be influenced by Body Mass Index and changes in body weight or metabolic status. Thus, the obese have been implicated as having greater preferences for sucrose than normal weight subjects. However, many researchers refute this (Drewnowski, 1991). Conner and Booth (1988) found that adiposity, assessed by body mass index was not associated with high or low levels of sugar snacking preferences. Similarly in the present study there were seen to be no changes in preferences for added sucrose despite significant changes in weight between weeks 1-8. This supports evidence which dismisses a link between BMI and liking for added sucrose. It is not possible to assume that those who are over weight have stronger preferences and therefore, may be at greater risk of over consumption.

It has been repeatedly observed within populations that high daily refined sugar intakes are associated with low body weight which can be interpreted as evidence that indiscriminate cutting back on sugar among those who are over weight makes no contribution to weight reduction (Booth 1987 and Westenhoefer, 1993). Nevertheless, cutting back on such foods is still an encouraged practice in weight reducing diets. This implies that habits of sugar taking in drinks and foods between meals induce a liking for sweetness in those contexts (Booth et al 1987) which has been associated with a higher body weight. The

present study shows this not to be the case. This is yet another reason to question why this practice still continues. Energy intakes in the form of fat are more likely to relate to difficulties in weight control.

Fat seems to be more heavily implicated as influencing dietary preferences, so that liking for fat is increased the more fat that is consumed and decreased the less that is eaten (Mattes, 1993). Studies have indicated that although obese subjects dislike the taste of intensely sweet solutions (Grinker, 1978) this contrasts with anecdotal responses of increased liking for sweet desserts (Yudkin, 1983). However, it should be noted that refined sugar in dessert type foods is often consumed in combination with dietary fats. The so called sweet tooth far from implying a craving from carbohydrate may reflect enhanced liking for foods containing sucrose and fats (Drewnowski et al, 1985). The present study did not measure preferences for mixtures of added sucrose and fat foods, and this may a topic for further research.

To conclude, it has been shown that obese subjects in this study did not opt for the strongest added sucrose solutions. It appears that exposure to the LSD and SCD had little influence on preferences for added sucrose solutions. Neither do subjects appear to be unable to control the amount of foods containing added sucrose they eat, as shown by the mean added sucrose intake on the SCD. Preferences for added sucrose in this study seemed to be unaffected by BMI and weight changes. However, it is accepted that the method used to test hedonic responses needed considerable refining, and also it may have been that individuals were not exposed to the diets for a long enough period to have any effect on taste. More research, clearly, is needed in this area, but, if these trends are confirmed, coupled with the effectiveness of weight reducing diets containing added sucrose (West Lean and de Looy, 1996), the arguments for continuing the practice of reducing it in such diets seem weak. Practitioners may be advised that added sucrose may have a place in low fat weight reducing diets and should not be routinely excluded.

7.0 CHAPTER SEVEN

Discussion.

7.1.1 Weight Loss and Compliance

Significant weight loss was seen to occur on both diets at an equal rate (2.2kg on the LSD and 3.0kg on the SCD) between weeks 1-8. This amount of weight loss was comparable in relation to other studies (see Table 13). Compliance rates (measured by predicted weight loss compared with actual weight loss) were similar at 43% on the SCD and only 33% on the LSD at the end of week 8. This was not significant between the groups. Measuring compliance rates in this way is not routinely done in weight loss programmes and so it was difficult to compare these percentages with other studies.

The SCD was as effective as the LSD and may, if the diets had continued beyond eight weeks and the trend maintained, have been more effective in promoting weight loss. This could have been because of the effects of carbohydrate on metabolic rate, but this seems unlikely because most of the studies which explore this link used amounts of carbohydrate which were much higher than would be normally consumed, (Hendler and Bonde, 1990, Lyon et al, 1995) and therefore, evidence to support this link should be viewed with caution. However, the effectiveness of the SCD may have been attributed to its effects on satiety between weeks 1-8. Blundell and Green (1996) suggest that carbohydrates both complex and simple sugars) have a substantial effect on satiety compared to fat (Cotton et al, 1994 and Blundell et al 1993) and to non-caloric sweeteners which may weaken appetite control (Blundell and Green, 1996).

Some researchers have reported difficulties in increasing complex carbohydrate to achieve higher carbohydrate consumption on weight reducing diets, because the diet may become too bulky (Bolton-Smith and Woodward, 1994). This was not the case on the SCD where subjects were able to increase carbohydrate by incorporating added sucrose in their diet, between weeks 1-8. The diet may have been less bulky and more acceptable and thus, promoted compliance.

Table 12: *Mean weight loss reported in other studies.*

Study	Intervention Group (n)	Intervention Period	Mean Weight Loss (kg)
Westenhoefer et al, (1993)	57	two weeks	2.3
Puska et al, (1983)	35	6 weeks	0.7
Sheppard et al, (1991)	184	6 months	3.2
Lean et al, (1992)	110	6 months	6.2
McCreery, (1991)	44	10 weeks	Females sugar diet 4.4 Females non-sugar 5.5 Males sugar diet 5.1 Males non-sugar diet 5.5
Hunningshake et al, (1993).	97	9 weeks	1.4
Kazim et al, (1993).	34	3 months	3.4
Shah et al, (1994).	47	6 months	4.4

However, foods containing added sucrose were received differently. Negative attitudes, shown in response to the attitudes and beliefs questionnaire, towards incorporating sugar containing foods in weight reducing diets, predominated and were maintained (on both the SCD and the LSD) throughout the study. Subjects came with negative preconceived ideas about added sucrose in weight reducing diets, which were difficult to over ride. Subjects on the SCD were 'prescribed' added sucrose, yet even after experiencing this diet their attitudes were still negative. Positive attitudes regarding reducing or omitting foods containing added sucrose persisted at week 8 even though weight loss had been achieved on the SCD. However, subjects who experienced the SCD for the first eight weeks maintained strong beliefs (perceived control) that they could 'lose weight', unlike those on the LSD.

When interviewed, many subjects stated that they liked the option of being able to incorporate foods containing added sucrose in their diet, but despite this some were rather cautious. Many found it difficult to 'let go' of beliefs that added sucrose promoted obesity,

and was usually 'forbidden' in weight reducing regimes. Gibney, (1995), suggests that "consumers have a belief that carbohydrate and sugars are fattening".. Attitudes and beliefs towards added sucrose and weight loss may significantly affect food choice (Shepherd, 1990) and may prohibit successful inclusion of it in weight reducing diets.

Taste has often been implicated as playing a major role in food choice (Shepherd, 1990) and as such is particularly relevant to this study. Drewnowski (1985) suggests that an increased responsiveness to sweet tasting foods, commonly known as a 'sweet tooth' is often quoted as a factor in the development and persistence of obesity, and perhaps this is why dietary advice often recommends the reduction of sucrose consumption and sugar containing foods (Dazzi and Dwyer, 1984). Some of the subjects on the SCD indicated that they were worried that once they started eating foods containing added sucrose they would be unable to stop, supporting the view that "obese individuals prefer sweet tasting substances in higher quantities than normal weight individuals, and that they are particularly unable to restrain themselves in the face of tempting foods" (Yudkin, 1973 and Wurtman et al 1981). However, Booth (1987) points out that it has been repeatedly observed within populations that high daily refined sugar intakes are associated with low body weight which can be interpreted as evidence that indiscriminate cutting back of sugar amongst those who are overweight makes no contribution to weight reduction. The present study indicates that the obese subjects did not show a preference for the sweetest solutions (6%) but, went for the medium strength solutions (4%). This was found throughout the length of the study irrespective of which diet subjects were on. Several researchers argue that no difference or a lower sweet preference for obese subjects compared with normal weight people occurs (Malcolm et al, 1980 and Grinker, 1977).

The present study also suggests that preferences for added sucrose are not affected by changes in BMI or weight, since preferences for sucrose solutions remained the same as at baseline even though weight loss occurred. This is unlike fat preferences which have been associated with body composition (Mela and Sacchetti, 1991). Energy intake was not seen to have any effect on preferences for sucrose solutions, despite energy deficits reported to

be over 800 kcals. Thus, manipulation of sugar on diets which limit and include added sucrose in a low energy context, do not seem to affect preferences for added sucrose solutions, but, further research is warranted in this area. Compliance rates may not be compromised if carbohydrate is included in weight reducing diets.

7.2 Dietary Composition

7.2.1 Carbohydrate and Fat.

Reported energy intake from fat was significantly lower than baseline on the SCD than the LSD at week 8. At week 8 in Group $B_{SCD-LSD}$ there was seen to be no change in percentage energy from added sucrose at baseline (10%), but there was a significant reduction in percentage energy from fat from (36.0% to 31.7%, $p<0.05$). This was not seen on the LSD. The present study has demonstrated that by encouraging higher added sucrose levels, total carbohydrate rose and fat intake spontaneously fell on the SCD. This supports the results of studies which encourage carbohydrate intake in normal weight individuals and have reported fat reduction (Burkhill et al, 1995, Prewitt et al, 1991). It has been suggested that sugar alone may be particularly important in enhancing carbohydrate intake (Bolton-Smith and Woodward, 1994, Hill and Prentice, 1995). Thus, subjects on the SCD may have achieved a higher carbohydrate:fat ratio, but the literature is conflicting. Golay et al, (1996) in closely supervised in-patients and Lean et al, (1992) in free living subjects found no difference in weight loss between high and low carbohydrate diets over a six month period. The results of the present study however, support work which advocate the use of carbohydrate in such programmes (Bolton-Smith and Woodward 1996).

Reducing fat consumption by increasing carbohydrate intake in weight reducing programmes may also have implications on satiety levels. Studies have shown that fat exerts a weaker effect on satiety than carbohydrate (Blundell et al, 1994). Since their was a higher intake of carbohydrate on the SCD it is postulated that its influence on satiety may have promoted compliance.

7.2.2 Micronutrient Intake

Refined sugar has often been described as a nutrient diluent (Heaton et al,1983) in that it provides 'empty calories'. However, apart from commercially formulated medical/nutritional products there are no foods which are nutritionally complete. Since the prescribed SCD was nutritionally balanced, there are little concerns about nutritional deficiencies on this diet, as confirmed in analysis. Indeed many of the micronutrients were seen to increase (in the same way as the LSD). Bolton-Smith and Woodward (1996) suggest that individuals can eat up to <20% energy from added sucrose without fear of micronutrient dilution. Similarly, Nelson, (1991) and Gibson (1992) argue that micronutrient intakes do not differ significantly between the top and bottom of sugar intake. The present study supports these studies, showing no indication that added sucrose compromised micronutrient status, even on energy reduced diets, which thus far has not been reported by other workers.

7.3 Weeks 9-16 - Under reporting

Between weeks 9-16 it was clear that subjects on both diets under reported or under ate on the days they reported but not on the remaining ones (Macdiarmid and Blundell, 1997). This was apparent since the reported energy deficit was over 800kcal on both diets and yet minimal weight loss was recorded. As such, recorded dietary intake during this period may not have given any meaningful results. Under reporting is frequently documented in obese subjects (Jebb and Prentice, 1995).

Some subjects seemed to fair worse when they changed onto the alternate diet, complaining that it had broken the eating pattern which they had established over the past eight weeks. However, as weight reducing diets progress motivation generally declines (Garrow, 1991), which is an important factor to acknowledge at this point. Future research might concentrate on keeping subjects on the same diet for sixteen weeks and observe effects on motivation, weight loss, dietary adherence and the recording of food intake using food record diaries.

7.4 *Summary*

1. Weight loss can be achieved at an equal rate by following either a weight reducing diet containing added sucrose or an isoenergetic one which is low in added sucrose over an eight week period.

2. Change to an alternative isoenergetic diet after eight weeks was not successful in promoting weight loss, on either diet.

3. The percentage energy from fat dropped significantly on the SCD and the percent carbohydrate increased, raising the carbohydrate:fat ratio compared to the LSD, weeks 1-8.

4. Compliance rates on the SCD as measured by weight loss, were equal to those on the LSD and did not differ by age or gender.

5. Attitudes and beliefs to diets containing added sucrose were seen to be negative. Many subjects had preconceived ideas that added sucrose should not be included in weight reducing diets, even though they demonstrably achieved weight loss on a sucrose containing diet. Such views may act as barriers to the successful implementation of weight reducing diets which contain added sucrose, and need to be measured before dietary intervention is prescribed.

6. Taste tests illustrated that exposure to low added sucrose diets and those containing added sucrose has little influence on preferences for sucrose solutions. There were seen to be no shifts in preference for added sucrose solutions in response to changes in body composition or energy deficit. The design of this part of the study, however, requires considerable refining and so these results should be observed with caution.

7.5 Conclusion.

Weight loss can be achieved by prescribing a diet containing 10% energy from added sucrose at a similar rate to an isoenergetic diet which is lower in commercially added

sucrose. Encouraging foods containing added sucrose as part of the energy allowance was shown to promote lower fat consumption. There may, therefore, be advantages in encouraging added sucrose allowance in weight reducing diets because as a more acceptable, less bulky form of carbohydrate it may result in increased satiety, can cause a reduction in dietary fat intake, and promote equal rates of weight loss and compliance as a low added sucrose reducing diet. Micronutrient intake was not compromised in either of the diets. The practice of banning added sucrose as part of low energy diets is, thus, unwarranted. Pre-existing negative attitudes, however, towards the inclusion of foods containing added sucrose could create barriers to it's inclusion and therefore, must be addressed before the practitioner can implement dietary intervention using this strategy.

7.6 Recommendations for Further Research

1. *A non-crossover study of 16 weeks*

Future research should focus on a parallel study where subjects follow the LSD or SCD for sixteen weeks, without switching diets. Interviews highlighted that subjects had difficulties changing over to the alternate diet, suggesting that it broke their routine, and this was reflected in the poor compliance and weight loss between weeks 9-16. A larger sample would be required, for this.

2. *Weight maintenance programme including added sucrose*

The long term follow up results showed that most subjects gained weight again three months after the diets had finished. The difficulties of maintaining weight loss have been frequently reported (Alpers et al, 1995). Although subjects did not return to their initial weight, trends showed that they may have done as time went on. Dietary intake was not measured during this period, because not enough subjects returned their food record diaries. Future research, should focus on weight maintenance regimes which incorporate added sucrose into a healthy diet.

3. *Repeating the study on clinically referred patients.*

Subjects in the present study were volunteers who were seen in the workplace. Many were highly motivated and not just on the programme because of a clinical referral. Implications for the use of diets containing added sucrose in therapeutic diets prescribed by health practitioners need to be tested in a clinical setting. Similarly, the benefits of measuring patients attitudes and beliefs to such diets, should also be piloted in dietetic practice.

4. *Repeat study using groups rather than individuals.*

Research indicates that slimming groups run by qualified professionals to promote weight loss offer several advantages over individual treatment (Bush et al, 1988). Dietetic departments have limited resources and need to investigate time saving, but, effective ways of treating obese patients. Group work was not possible in the present study, because

managers were not prepared to release large numbers of their staff all at once. Further research, could repeat the programme on groups and monitor compliance rates, either in a clinical or work environment.

5. *Deeper investigations into the attitudes and beliefs of obese subjects following weight reducing diets.*

Because of time constraints and the numerous requests placed on the subjects in the present study (food record diaries, questionnaire, taste tests, weight measurements) the questionnaire used to measure attitudes and beliefs was modified and shortened. Future research might repeat the study and include questions on normative beliefs and outcome evaluations, as suggested by Ajzen, (1988). Such interventions might provide a deeper insight into the predictors of the behaviour of those following weight reducing programmes, and may identify barriers or promoters of compliance.

Although the attitudes and beliefs data in the present study shows negative views about incorporating added sucrose into the diet, strategies to change such beliefs need to be investigated, before it can be used effectively in weight reducing programmes. Further research into this area is thus, merited.

6. *Mood, food and added sucrose.*

A standard method of recording social/emotional circumstances and their effects on compliance, is recommended for future research. As the study went on it became apparent that these factors had a considerable effect on successful weight loss and dietary adherence. Index cards were used to record events, for example, holidays and illness, or emotional circumstances which caused subjects to deviate from the diets. However, the data were not quantifiable and a more structured approach to measure these issues and understand their effects on compliance is indicated. A mood diary to measure how subjects felt following the diets could register feelings of guilt, boredom, anxiety, stress, contentment and so on.

7. *Weight loss and compliance.*

Weight loss in the present study occurred in subjects who complied with the prescribed diets, but, also in individuals who self prescribed very restrictive diets, which often resulted in very rapid weight loss. This was not desirable because lean tissue as opposed to fat would be lost, and other nutrients compromised (Garrow, 1991).

Many subjects on the LSD found it difficult and impractical to consume less than 5% added sucrose each day. Some subjects on the SCD, also struggled to incorporate 10% added sucrose in their daily diet. It must be stressed in future studies that weight loss will only occur if prescribed amounts are adhered to. Further strategies to promote adherence to dietary prescriptions, which are not too invasive, need to be developed in future research.

Difficulties in ensuring full compliance remain challenging and future research should endeavour to seek methods which minimise poor dietary adherence.

8. *Taste.*

A more sophisticated, in-depth study on the sweet preferences of obese individuals following low sucrose and sucrose containing weight reducing diets needs to be developed.

9. *Other relevant factors.*

This study has attempted to identify factors which affect compliance to traditional energy reduced, low sugar, low fat diets and isoenergetic diets which incorporate added sucrose. Dietary composition, attitudes and beliefs and taste have been considered, but, in the quest to improve success rates in the treatment of obesity, a multifactorial approach, which incorporates behavioural, social, political, economic, sensory and nutritional aspects, seems to be the only way forward. The present research has considered some of these, and future research needs to explore compliance using a more global approach

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APPENDIX 1

WEIGHT REDUCTION STUDY

INFORMATION BOOKLET

Weight Reducing Study

The purpose of this study is to compare two weight reducing diets. Both diets are carefully designed to be of equal calorie value, so that body weight should be lost equally while on the two diets. It is expected that weight loss will be at a steady rate of 1-2lb (0.5-1kg) per week. This has been found to be a good rate of weight loss, because it means that you are more likely to keep the weight off when you finish the diets.

Dieting can be difficult. By taking part in this study, you have the support and expertise of a qualified dietitian. If you keep to the diets rigidly then you will lose weight. It is very important that you eat everything you are told to eat - if you eat less then you may lose weight too quickly which could mean that you will be more likely to put the weight on after you stop the diet. As this is a research study it is vital that you follow the instructions given to ensure your success and the success of the study.

If, after the initial interview you feel unable to seriously commit yourself, then you may opt out, but please come and have a chat with me about your decision. My name is Janet West and I can be contacted on (0131) 317 3525.

What the study will involve for you.

1. You will be interviewed initially to estimate your current food intake. These interviews will take 15 minutes and take place before the main study begins. You will also have to keep a food record diary of what you eat for a few days. It is essential that this information is accurate in order for me to design the diets so that your weight loss of 1-2lbs (0.5-1kg) per week will occur.

You will be asked to answer simple a simple questionnaire on how you feel about dieting.

2. You will then be placed on either Diet A or Diet B. You will be seen for 10-15 minutes at the first session to :

(i) Measure your weight and height.
(ii) Measure your liking and disliking for the taste of lemon flavoured solutions.
(iii) Ask you to record your food intake for 2 days on weeks 2, 4 and 8 of each diet.

3. You will be seen on a specific day, by appointment, once a fortnight for 10 minutes to :
   - weigh you
   - talk over your diet
   - collect in record sheets
   - review any problems.

4. After 8 weeks you will be:

   - given the alternate diet
   - given another test to measure your likings for the lemon flavoured solutions.
   - asked to fill in another questionnaire on how you feel about dieting.
   - be seen at 2 week intervals from then on.

5. At week 16 you will be :

   - given a final taste test to measure your likings for lemon flavoured solutions.

- asked to complete a final questionnaire on how you feel about dieting.

To ensure that no problems interfere with its progress, I will be available on (0131) 317 3525, if you need any advice. In addition I may telphone you from time to time to see how you are getting on.

Having had all this explained to me I am still keen to continue

NAME.....

Signature.....

ALL THE INFORMATION COLLECTED IS CONFIDENTIAL TO YOU AND ME. WHEN I HAVE ANALYSED THE DATE, ALL RECORDS THAT YOU COMPLETE WILL BE DESTROYED OR YOU MAY HAVE THEM BACK.

GENERAL INSTRUCTIONS

In the interests of your own success, and the success of the study, you must follow instructions carefully.

1. It is important to stay within the allowances for different food groups as stated in the diet sheets.

As with any other weight reducing diet, it is generally accepted that you must avoid:

Fried fatty foods e.g.:

Dripping	Salad dressing	Fatty meats	Fried savoury snacks
Lard	Mayonnaise	Salami	Nuts
Cream	Salad Cream	Spam	Crisps
Tinned milk		Sausages	Fried meals e.g. fish and chips.

Extra butter, margarine and oil other than daily allowance.

2. Apart from your daily allowances in this study you will need to avoid:

Sugar	Marmalade	Sorbitol	Icecream	Instant desserts
Glucose	Lemon curd	Chocolate	Mousses	Yoghurt
Jam	Syrup	Peppermints	Jellies	
Honey	Treacle	Confectionery		

Sweet fruit squash, soft drinks, sweetened fizzy drinks e.g.

Lucozade, Coca cola, Lemonade.

Also:

Malted milk drinks
Drinking chocolate
Tinned and packet soups.

3. It is extremely important to complete the food record diaries for 2 days on weeks 2, 4 and 8 (on each diet) and that everything you consume be included. Even if you exceed your daily allowance, please make sure you record this. This will enable the researcher to monitor your food accurately which is a vital part of the study.

4. Please make known to me any problems that you experience on the diets at each interview/weight check so that these can be sorted quickly. I am also available by phone in between interviews.

5. It is crucial to the study that you complete the questionnaires on 'How you feel about dieting':

- before commencing the study.
- at week 8.
- at week 16.

6. GOOD LUCK. I am sure we can succeed together.

MY RECORD

WEEKS

BEGIN DIET

PRESTUDY		1	2		3		4	5		6	7		8	SWITCH DIETS
ESTIMATE OF CURRENT FOOD INTAKE	TASTE TESTS. Q'NNAIRE 'How you feel about dieting'.	DIET DIARY INTERVIEW	W E I G H T	DIET DIARY INTERVIEW	W E I G H T		W E I G H T	DIET DIARY INTERVIEW	W E I G H T	TASTE TESTS. Q'NNAIRE 'How you feel about dieting'.				

COMMENCE NEW DIET

1	2		3	4		5	6		7	8
DIET DIARY INTERVIEW	W E I G H T	DIET DIARY INTERVIEW	W E I G H T		W E I G H T	DIET DIARY INTERVIEW	W E I G H T	TASTE TESTS. Q'NNAIRE 'How you feel about dicting'.		

WEIGHT RECORDS

START WEIGHT.....

DIET A	DIET B
Week 2.....	Week 2.....
Week 4.....	Week 4.....
Week 6.....	Week 6.....
Week 8.....	Week 8.....

My name is Janet West, I am a qualified dietitian and I can be contacted at the department of Dietetics and Nutrition at Queen Margaret College, Clerwood Terrace, Edinburgh EH12 8TS. Telephone (0131) 317 3525. My work is sponsored by a large commercial company and a revision of this project will be submitted as an M.Phil.

If you are interested in participating in the weight reduction programme, please complete the above form and send to Claire Saddler, Room 204. Confidentiality will be respected throughout the study.

APPENDIX II

WEIGHT REDUCTION STUDY

Name:.....

Department Address: .....

Date of Birth:.....

Tel. Ext:.....

Are you currently seeing your medical practitioner for the treatment of :

obesity
hypertension
diabetes

yes..... no.....

Why do you want to lose weight ?.....
.....
.....

Have you tried to lose weight before ? yes..... no.....

If so when was this ?.....

Who advised you ?.....

For how long have you been this weight ?.....

What is your weight now .....stones or kg

What is your height now ? .....feet & inches or cms.

I understand that the programme is voluntary and that I can discontinue at any time. Having had all the details of the weight reducing programme explained to me, I am still keen to continue.

NAME.....

DATE.....

ALL THE INFORMATION COLLECTED IS CONFIDENTIAL TO YOU AND ME. NONE OF THE MANAGERIAL STAFF OR THE OCCUPATIONAL HEALTH STAFF WILL HAVE ACCESS TO THE DATA YOU GIVE ME. WHEN ASSESSMENT OF THE STUDY IS CONCLUDED, ALL RECORDS OF THAT YOU COMPLETE WILL BE DESTROYED OR YOU CAN HAVE THEM BACK.

APPENDIX III **DIET A**

DAILY ALLOWANCES

MILK
1/2 pint (250 ml) whole milk.
OR
3/4 pint (375 ml) semi-skimmed milk.
OR
1 pint (500 ml) skimmed milk.
4 tablespoons skimmed milk powder (without added vegetable fat).

FRUIT
No more than____portion/s(exchange/s) a day.
One portion is approximately :
4oz (120g) apple.
4oz (120g) pear.
4oz (120g) orange.
4oz (120g) banana etc.
Fresh fruit, frozen and cooked fruit, without sugar, or tinned fruit in natural juice can be used.
A small glass of unsweetened fruit juice counts as a portion of fruit.

BREAD
Select___ portions (exchanges) of the following each day :
1 slice bread from a large medium sliced loaf.
2 small thin slices of bread.
1 medium chapatti without ghee.
2 egg-sized potatoes (4oz, 120g) mashed, boiled or baked in jacket.
3oz (90g) cooked pasta - small portion.
3oz (90g) boiled rice -small average portion.
loz (30g) unsweetened breakfast cereal (5 tablespoons).
3 crispbread.
2 semi-sweet biscuit or crackers.

Try to have whole grain cereals, wholemeal bread, brown rice and pasta.

ALCOHOL
Select no more than **one** item from the following list, each day:
4oz (125g) white wine, dry, medium or sparkling - 1 average glass.
4oz (125g) red wine - 1 average glass.
4oz (125g) rose wine, medium - 1 average glass.
loz (28g) Spirits 70% proof - 1 measure.
10oz (287g) Low alcohol beer- 1/2 pint.

PROTEIN FOODS

Have____ portions from the following list each day :

LEAN MEAT

2oz (60g) cooked weight or 4oz (120g) raw weight. This includes beef, lamb, pork, ham, lean bacon, poultry (no skin) liver, kidney.

Cook without adding fat and avoid thickened gravies. It is advisable to eat foods rich in iron eg. liver, kidney and corned beef.

FISH

4oz (120g) cooked weight of white fish, eg. cod, plaice, haddock, etc.

OR

2oz (60g) oily fish, eg. mackerel, kipper, trout, sardines, etc.
Avoid fried fish or sauces. If using tinned fish, drain off the oil or try tinned fish in brine.

CHEESE.

loz (30g) hard cheese eg. cheddar.

OR

1.5oz (45g) camembert type OR lower fat hard cheeses eg. Edam, Gouda, Tendale/Shape

OR

4oz (120g) cottage cheese, or other skimmed milk soft cheese.
Avoid cream cheese or cheese spread.

EGGS

1-2 boiled or poached or cooked without fat, eg. scrambled or omelette.

BEANS AND PULSES

4oz (120g) cooked weight, eg. lentils, baked beans, butter beans and kidney beans, etc.

Meat, fish, egg, cheese, beans and pulses are the main protein foods. Include at least one at two meals a day for good health. They are quite high in energy so avoid large portion

FATS AND OILS WEEKLY ALLOWANCE

Either 5oz (150g) butter, margarine, or oil, or 10oz (300g) low fat spread eg. Gold, Delight, Latta. If using a margarine or oil, try to use a polyunsaturated one eg. sunflower margerine or corn oil.

FOODS ALLOWED FREELY:

VEGETABLES eg. Cabbage, carrots, cauliflower, green beans, courgettes, marrow, mushrooms, onions, *parsnips, *peas, *swede, spinach, sprouts and turnips.

SALAD VEGETABLES eg. Celery, cucumber, lettuce, pepper, radish, tomatoes, beetroot, etc. and pickles in vinegar.

SOUPS
Clear soup - either home-made or consommé, stock cubes, Bovril, Marmite and Oxo.

SEASONING
Worcester sauce, herbs, spices, pepper, oil free salad dressing, mineral water.

SALT
Take care with salt - use a little in cooking but try not to add at the table.

NB
* = Keep to a small portion of root vegetables, peas, beans and sweet corn.

FOODS TO AVOID:

SUGARY FOODS
Apart from daily allowance you must avoid:

Sugar, glucose, jam, honey, marmalade, lemon curd, syrup, treacle , sorbitol, chocolate, peppermints and confectionery. Ice-cream, mousses, ice lollies, jellies, instant desserts, ordinary fruit yoghurt.

FATTY FOODS
Fried foods, dripping, lard, cream, tinned milk.
Salad dressing, salad cream, mayonnaise, and sweet pickle.
Fried savoury snacks, nuts, and crisps.
Fatty meats, eg. salami, spam or luncheon meat.
Extra butter, margarine and oil other than daily allowance.

DRINKS
Apart from daily allowances you must avoid:

Sweet fruit squash, soft drinks, sweetened fizzy drinks, eg. lucozade, cola, and lemonade. Malted milk drinks and drinking chocolate. Tinned and packet soup.

ALCOHOL Beer, lager, stout, ale, cider, spirits, wine, sherry and liquors.

CEREALS

Apart from daily allowance you must avoid:

Sugar coated breakfast cereals, muesli, semolina, sago, tapioca, rice puddings. Cakes, sweet biscuits, pastry, pies, scones, tinned spaghetti.

FRUIT

Apart from daily allowance you must avoid. Fruit tinned in syrup or sorbitol and dried fruit.

PROPRIETY FOODS

Slimming and diabetic foods. Artificial sweeteners eg.Saxin, Sweetex, Hermesetas, Canderel, Nutrasweet, Sucron, Boots Shapers and Sugarlite.

It is important to eat regularly and not to miss meals. A suitable meal pattern is shown below.

SUGGESTED MEAL PLAN

Use milk from your daily allowance for tea coffee and cereals.

BREAKFAST
Grapefruit
4 tablespoons Cornflakes
Egg, fish, meat, beans, or cheese if desired (see portion guide.) Tomatoes or mushrooms cooked without fat. AND 1 slice of bread or 2 small potatoes.
Tea or coffee.

MID-MORNING
Tea, coffee, or Oxo.
1 Rich Tea Biscuit.

MID-DAY OR EVENING
Clear soup if liked
Meat, fish, cheese, egg or beans (see portion guide.)
Salad or cooked vegetables
1 slice of bread or 2 small potatoes.
Apple.

MID-AFTERNOON
Tea, coffee, or Oxo.
1 Rich Tea Biscuit.

EVENING OR MID-DAY
Clear soup if liked.
Meat, fish, cheese, egg, or beans
2 slices of bread (or 2 equivalent portions from bread exchange list.)
4oz tinned peaches in natural juice.

BEDTIME
Tea, coffee, Oxo, or remainder of milk from allowance.

SENSIBLE SLIMMING TIPS

1. Have regular meals.

2. Try to sit down and have your meals.

3. Do not fry foods. Grill, roast, stew, braise, steam, or poach.

4. Do not add fat during cooking.

   - Roast meat covered in foil for half the cooking time to avoid basting.

   - Meat for casseroles does not need prefrying; add different vegetables to flavour.

   - Brown mince on its own and drain off any fat before further.

5. Avoid adding sugar to drinks and cereals.

6. Useful low calorie salad dressings are lemon juice, vinegar, tomato juice and plain yoghurt.

7. If you feel hungry have a hot drink or some raw vegetables eg. carrot, celery, cucumber.

8. Set yourself a realistic target and aim for a steady gradual weight loss.

9. Only weigh yourself once a week.

REMEMBER: It is important to develop good eating habits to maintain your target weight.

APPENDIX III

DIET B

DAILY ALLOWANCES

MILK
1/2 pint (250 ml) whole milk.
OR
3/4 pint (375 ml) semi-skimmed milk.
OR
1 pint (500 ml) skimmed milk.
4 tablespoons skimmed milk powder (without added vegetable fat).

FRUIT
No more than___ portion/s (exchange/s) a day.
One portion is approximately :
4oz (120g) apple.
4oz (120g) pear.
4oz (120g) orange.
4oz (120g) banana etc.
Fresh fruit, frozen and cooked fruit, without sugar, or tinned fruit in natural juice can be used.
A small glass of unsweetened fruit juice counts as a portion of fruit.

BREAD
Select___ portions (exchanges) of the following each day :
1 slice bread from a large medium sliced loaf.
2 small thin slices of bread.
1 medium chapatti without ghee.
2 egg-sized potatoes (4oz, 120g) mashed, boiled or baked in jacket.
3oz (90g) cooked pasta - small portion.
3oz (90g) boiled rice -small average portion.
loz (30g) unsweetened breakfast cereal (5 tablespoons).
3 crispbread.
2 semi-sweet biscuit or crackers.

Try to have whole grain cereals, wholemeal bread, brown rice and pasta.

ALCOHOL
Select no more than **one** item from the following list, each day:
4oz (125g) white wine, dry, medium or sparkling - 1 average glass.
4oz (125g) red wine - 1 average glass.
4oz (125g) rose wine, medium - 1 average glass.
loz (28g) Spirits 70% proof - 1 measure.
10oz (287g) Low alcohol beer- 1/2 pint.

MISCELLANEOUS

You **must** have ___ exchanges from the list below, daily. Select just ___ item from SECTION A and another from SECTION B.

SECTION A.

Select just---- item from this section.

1.4oz (35g) Sugar Puffs - 6 tablespoons.
2oz (60g) Crunchy Nut Cornflakes - 8 tablespoons.
1.5 oz (45g) Frosties - 7 tablespoons.
1.5oz (45g) Coco Pops - 10 tablespoons.
1.5oz (45g) Ricicles - 10 tablespoons.
1.5oz (45g) Honey Smacks - 8 tablespoons.

3oz (90g) Arctic Roll - 1 medium slice.
2.5oz (45g) Gateaux with synthetic cream - 1 small slice.
3oz (90g) Commercial type mousse - small portion.
2.5oz (45g) Chocolate cake (1 layer icing) - small slice.
2.5oz (45g) Battenburg Cake - small slice.

5oz (150g) Low Fat Yogurt - 1 carton.
5oz (150g) Fromage Frais - 1.5 cartons.
5oz (150g) Fruit Salad, canned in syrup.

2.5oz (45g) Flapjack - 1 small slice.
3oz (90g) Full coated chocolate biscuit, eg. Club - 1.5 Biscuits.
3oz (90g) Non-dairy icecream - 1 1/4 blocks.
1oz (28g) Chocolate (milk)- 4 squares.
1oz (28g) Chocolate (plain) - 4 squares.
1oz (30g) Bounty Bar - small bar.
1oz (28g) Mars Bar - 1/4 regular bar.
(35g) Chocolate Wholenut - 5 squares.
(35g) Chocolate Fruit and Nut - 5 squares.

(45g) Jam with edible seeds - average spreadings for 2 slices of bread.
(40g) Lemoncurd - average spreadings for two slices of bread.

SECTION B

You must select----- items from this section.
3oz (90g) Grapefruit canned in syrup - medium portion.
4oz (120g) Peaches canned in syrup - medium portion.
4oz (120g) Pineapple canned in syrup - medium portion.
3oz (90g) Raspberries canned in syrup - medium portion.
3oz (90g) Strawberries canned in syrup - medium portion.
3oz (90g) Blackcurrents canned in syrup - medium portion.
2.5oz (75g) Apricots canned in syrup - medium portion.
5oz (150g) Pears canned in syrup - medium portion.
3oz (90g) Gooseberries canned in syrup - medium portion.
6oz (180g) Jelly - small bowl, 1/3 pint.

(35g) Fruit Gums - 1 tube.
(24g) Liquorice Allsorts - 3 sweets.
(24g) Fruit Pastilles - 8 sweets.
(18g) Peppermint Creams - 3 sweets.

(22g) Toffees - 3 sweets.
(18g) Boiled sweets- 2-3 sweets.

(150ml) Coca cola - 1/2 can.
(275ml) Lemonade - 3/4 can.
(65g) Orange drink (concentrated).
(60g) Lime juice cordial (concentrated).
(160g) Lucozade - 1/2 can.
(15g) Nesquik Powder - 3 rounded teaspoons. (use milk from allowance.)
(22g) Drinking Chocolate 3-4 round teaspoons. (use milk from allowance)
(25g) Marmalade - 1 dessertspoon.
(20g) Honey - 1 average spread for one slice of bread.
(20g) Chocolate Spread - 1 average spread for one slice of bread.

PROTEIN FOODS

Have____ portions from the following list each day :

LEAN MEAT
2oz (60g) cooked weight or 4oz (120g) raw weight. This includes beef, lamb, pork, ham, lean bacon, poultry (no skin) liver, kidney.

Cook without adding fat and avoid thickened gravies. It is advisable to eat foods rich in iron eg. liver, kidney and corned beef.

FISH
4oz (120g) cooked weight of white fish, eg. cod, plaice, haddock, etc.

OR
2oz (60g) oily fish, eg. mackerel, kipper, trout, sardines, etc.
Avoid fried fish or sauces. If using tinned fish, drain off the oil or try tinned fish in brine.

CHEESE.
loz (30g) hard cheese eg. cheddar.

OR
1.5oz (45g) camembert type OR lower fat hard cheeses eg. Edam, Gouda, Tendale/Shape

OR
4oz (120g) cottage cheese, or other skimmed milk soft cheese.
Avoid cream cheese or cheese spread.

EGGS
1-2 boiled or poached or cooked without fat, eg. scrambled or omelette.
BEANS AND PULSES
4oz (120g) cooked weight, eg. lentils, baked beans, butter beans and kidney beans, etc.

Meat, fish, egg, cheese, beans and pulses are the main protein foods. Include at least one at two meals a day for good health. They are quite high in energy so avoid large portion

FATS AND OILS **WEEKLY ALLOWANCE**

Either 5oz (150g) butter, margarine, or oil, or 10oz (300g) low fat spread eg. Gold, Delight, Latta. If using a margarine or oil, try to use a polyunsaturated one eg. sunflower margerine or corn oil.

FOODS ALLOWED FREELY:

VEGETABLES eg. Cabbage, carrots, cauliflower, green beans, courgettes, marrow, mushrooms, onions, *parsnips, *peas, *swede, spinach, sprouts and turnips.

SALAD VEGETABLES eg. Celery, cucumber, lettuce, pepper, radish, tomatoes, beetroot, etc. and pickles in vinegar.

SOUPS
Clear soup - either homemade or consomme, stock cubes, Bovril, Marmite and Oxo.

SEASONING
Worcester sauce, herbs, spices, pepper, oil free salad dressing, mineral water.

SALT
Take care with salt - use a little in cooking but try not to add at the table.

NB
* = Keep to a small portion of root vegetables, peas, beans and sweetcorn.

FOODS TO AVOID:

SUGARY FOODS
Apart from daily allowance you must avoid:

Sugar, glucose, jam, honey, marmalade, lemon curd, syrup, treacle , sorbitol, chocolate, peppermints and confectionary. Icecream, mousses, ice lollies,jellies, instant desserts, ordinary fruit yogurt.

FATTY FOODS
Fried foods, dripping, lard, cream, tinned milk.
Salad dressing, salad cream, mayonnaise, and sweet pickle.
Fried savoury snacks, nuts, and crisps.
Fatty meats, eg. salami, spam or luncheon meat.
Extra butter, margarine and oil other than daily allowance.

DRINKS
Apart from daily allowances you must avoid:

Sweet fruit squash, soft drinks, sweetened fizzy drinks, eg. lucozade, cola, and and lemonade. Malted milk drinks and drinking chocolate. Tinned and packet soup.

ALCOHOL Beer, lager, stout, ale, cider, spirits, wine, sherry and liquers.

CEREALS
Apart from daily allowance you must avoid:

Sugar coated breakfast cereals, muesli, semolina, sago, tapioca, rice puddings. Cakes, sweet biscuits, pastry, pies, scones, tinned spaghetti.

FRUIT

Apart from daily allowance you must avoid. Fruit tinned in syrup or sorbitol and dried fruit.

PROPRIETY FOODS

Slimming and diabetic foods. Artificial sweeteners eg. Saxin, Sweetex, Hermesetas, Canderel, Nutrasweet, Sucron, Boots Shapers and Sugarlite.

It is important to eat regularly and not to miss meals. A suitable meal pattern is shown below.

SUGGESTED MEAL PLAN

Use milk from your daily allowance for tea coffee and cereals.

BREAKFAST
Grapefruit
1.5oz (45g) Frosties - 7 tablespoons.
Egg, fish, meat, beans, or cheese if desired (see portion guide).
Tomatoes or mushrooms cooked without fat.

Tea or coffee.

MID-MORNING
Tea, coffee, or Oxo

MID-DAY OR EVENING
Clear soup.
Meat, fish, cheese, egg or beans (see portion guide).
Salad or cooked vegetables.
1 slice of bread or 2 small potatoes.
Banana.

MID-AFTERNOON
Tea, coffee, or Oxo.
3 toffees.

EVENING OR MID-DAY
Clear soup.
Meat, fish, cheese, egg, or beans.
2 slices of bread (or 2 equivalent portions from bread exchange list).
6oz Jelly - 1/3 pint, small bowl.

BEDTIME
Tea, coffee,Oxo, or remainder of milk from allowance.

SENSIBLE SLIMMING TIPS

1. Have regular meals.

2. Try to sit down and have your meals.

3. Do not fry foods. Grill, roast, stew, braise, steam, or poach.

4. Do not add fat during cooking.

   - Roast meat covered in foil for half the cooking time to avoid basting.

   - Meat for casseroles does not need prefrying; add different vegetables to flavour.

   - Brown mince on its own and drain off any fat before further.

5. Avoid adding sugar to drinks and cereals.

6. Useful low calorie salad dressings are lemon juice, vinegar, tomato juice and plain yogurt.

7. If you feel hungry have a hot drink or some raw vegetables eg. carrot, celery, cucumber.

8. Set yourself a realistic target and aim for a steady gradual weight loss.

9. Only weigh yourself once a week.

REMEMBER: It is important to develop good eating habits to maintain your target weight.

APPENDIX IV

FOOD AND DRINK RECORD

NAME _____

ADDRESS _____

_____

CODE NO. |_|_|_|

DATE |_|_|_|_|_|_|

RECORD TO START ON _____ |_|_|_|_|_|_|

RECORD TO FINISH ON _____ |_|_|_|_|_|_|

PLEASE:
Write down *everything* you eat and drink each day for 3 days . Include all meals, snacks, plus sweets and drinks etc.

Only write down what you *actually* eat , not what you start off with on your plate. DO NOT include leftovers on your food record.

Write down the foods and drinks immediately after you have eaten them , NOT from memory at the end of the day.

Remember, it is *very important* that you do not change what you normally eat while you are keeping this record.

See the next pages for an example and guidelines on how to keep your record.

DESCRIBING FOOD AND DRINK - GUIDELINES

Please write down what you have to eat and drink giving as much detail as possible about each item.

COOKING METHODS

Write down how your food has been cooked eg .

- Are your eggs boiled, fried, poached or scrambled ?
- Are your potatoes boiled, mashed, baked or chipped?
- Is your bacon grilled or fried ?

BRAND NAMES

Write down the brand name of foods where you can eg.

BLUE BAND margarine, JACOBS cream crackers

NAME

Name the type of biscuit , cake and cereal you eat eg. digestive biscuit, fruit cake, weetabix .

Name the type of cheese, fish or meat you eat eg. Dairylea cheese spread, haddock, pork chop.

MADE UP DISHES

Please write down what the dish is called and give the ingredients if you can eg. Stew (with beef , carrots, onions and gravy.)

SAUCES AND DRESSINGS

Please do not forget to include sauces (eg tomato ketchup, cheese sauce) , salad dressings and gravy when completing your record.

TO SHOW THE AMOUNT OF FOOD YOU EAT

In the 'amount eaten' column of your record, you should write down the quantity of *each* item that you have eaten or drunk. Use the following guidlines to help you .

* Give the *number* of cups of tea/coffee, rashers of bacon, eggs, biscuits, sweets , slices of meat, slices of bread (remember to describe the type of bread and whether it is thick, medium or thin sliced)

* The amount you eat of some foods can be described as:

  - Cupfuls eg. cereal, soup, drinks
  - Tablespoonfuls (Tabs) eg. vegetables, cereals , casseroles , minced meat , gravy, sauces , baked beans, puddings.
  - Teaspoonfuls (teasp) eg. sugar, jam, butter

* Use comparisons for describing the amount you have eaten eg.

  - potato (size of hens egg)
  - cheese (size of ordinary matchbox)

* Use the weights marked on tinned and packet foods eg. *half a 15 oz* can of baked beans.

* If you need to , describe the amounts of food you eat as :

  - small / medium / large

  OR - thin / medium / thick

  eg. small banana , thick slice cream cake

POINTS TO REMEMBER

* If you wake up in the middle of the night and have something to eat or drink, write what you had on the record of the day you have just finished.

* If you wake up and have something to eat or drink after 5 am in the morning , start a new page on your record and write the new day and date on each page that you use for that day.

* Use as many pages for each days record as you need.

* Remember to write only *one item on each line* on your record eg. if you have a cheese and tomato sandwich write each of the ingredients (the cheese,tomato, bread and the butter) on separate lines not forgetting to write how much you ate of each in the 'amount eaten' column.

* Leave a line between each meal or snack that you have.

* Remember to write the time down in your record whenever you have something to eat or drink.

* If you eat away from home eg. at a lunch club, friends, restaurant , take your record with you and write down what you have eaten as normal.

* It is impotant that you get into the habit of writing down all foods and drinks immediately after you have eaten them, NOT from memory at the end of the day.

Example

DESCRIPTION OF FOOD AND DRINK

DAY Monday DATE 10 December 1990

ONE ITEM PER LINE

LEAVE A LINE AFTER EACH SNACK OR MEAL

START A SEPARATE PAGE FOR EACH DAY

TIME	AMOUNT EATEN	DETAILS OF FOOD AND DRINK	LEAVE BLANK
6 am	1 cup	tea	
9am	2 cups	tea	
	2 medium slices	white bread toasted	
	2 teaspoons	butter	
	2 teasp.	marmalade	
11am	1 mug	coffee	
	3	custard cream biscuits	
1.45 am	2	peppermints - polos	
12 noon	2 small	grilled lamb chop (with fat cut off)	
	3 table spoons (Tabs)	thick gravy	
	3 scoops	mashed potato	
	1 Tabs	peas (frozen)	
	thin slice	fruit cake	

DAY Monday DATE 10 December 1990

ONE ITEM PER LINE

LEAVE A LINE AFTER EACH SNACK OR MEAL

START A SEPARATE PAGE FOR EACH DAY

TIME	AMOUNT EATEN	DETAILS OF FOOD AND DRINK	LEAVE BLANK
3 pm	4 squares	Cadbury's milk chocolate (17p bar)	
4 pm	1 cup	tea	
5.30 pm	twice size of matchbox	Scottish cheddar cheese	
	1/2 inch	cucumber (not peeled)	
	2 medium thin slices	cold boiled ham (with fat)	
	2 thick slices	Mothers Pride white bread (no butter)	
	2 Tabs	apple crumble (home made)	
	3 Tabs	custard	
7 pm	1 small glass	sweet sherry	
9.30 pm	1 mug	drinking chocolate (made with milk)	
	2	oatcakes (plain)	
BED)			
3 am	small glass	milk	

APPENDIX V.

STANDARD INTERVIEW QUESTIONS.

1. How have you been getting on since I last saw you?

2. Have you been following the diet as prescribed?

3. Have you experienced any adverse symptoms over the last two weeks? For example, hunger, tiredness.

4. Have you been to any social events since I last saw you, which prevented you from following the diet properly?

5. Have you found yourself eating to relieve boredom, or for comfort, for example when depressed or worried?

6. Have you been ill since I last saw you? If so was your diet very different during this period?

7. Which of the exchanges from the miscellaneous section have you chosen the most over the past two weeks?

8. Which of the exchanges from the miscellaneous section would you prefer over the next two weeks?

Appendix VI

The Pilot Study

The pilot study was undertaken on 21 subjects from a large educational establishment for 16 weeks to evaluate the study design and check that the diet sheets and food record diaries were easy to understand, user friendly and that they induced weight loss. Because the number of subjects on each of the diets were unequal, (making initial distribution of weight different) and the sample size was so small, reported results could not be statistically compared but show interesting trends and highlight problems with the study design pointing to useful recommendations for the main study.

CONTENTS

1.O INTRODUCTION

This pilot study examines whether the inclusion of foods containing added sucrose in weight reducing diets increases compliance.

1.1 Prevalence and Difficulty in Treatment

Obesity and overweight are among the most common preventable health problems today. About one third of the UK population is overweight, that is with a Body Mass Index (BMI) in excess of 25, and many more are trying to lose weight. Obesity is one of the most important avoidable risk factors for a number of life threatening diseases and for serious morbidity (Garrow, 1992). However, success rates in weight loss are notoriously poor (Stunkard 1972, Wing and Jeffrey 1979, Leelarthaepin and Steinbeck 1980, Pacey et at al 1987, Garrow 1981, Stein et al 1981).

1.2 Compliance and Weight Loss

This project considers why dietary compliance, reflected by weight loss is so low. Compliance has been defined as "action in accordance to a request or command" (Concise Oxford Dictionary, 1986). In relation to dietary advice their are many factors affecting compliance including knowledge about the diet (Bradley and Theobald 1988), understanding the information given (Ley, 1989) and motivation.

Several other factors have been identified as influencing the successful outcome of obese patients specifically. These include, age (Leelarthaepin and Steinbeck 1980), sex (Craddock 1977), initial weight (Leelarthaepin and Steinbeck 1980), onset of obesity (Cooper et al 1979) family history (Douglas et al 1981), to name a few.

Dietary composition is of particular interest when observing compliance rates. It is possible that deviations from weight reducing diets may be due to the exclusion or severe reduction of popular foods such as added sucrose and products containing it. This study investigates whether omitting foods that contain added sucrose, a traditional feature of weight reducing diets is a factor in compliance, and will test how the use of these in future weight reducing therapy might increase compliance and thus, promote weight loss. McCreery (1991) suggests that advice for the complete exclusion of added sucrose from balanced energy deficit diets is not necessary for successful weight reduction. The COMA Report (1989)

'Dietary Sugars and Human Diseases' could not find sufficient evidence to support the link between (non-milk extrinsic) sugar and the development of obesity and little other evidence exists to validate it as a significant contributor to this condition.

1.3 Carbohydrate and Fat

Some research indicates that the removal of added sucrose from weight reducing diets may cause an increase in fat intake (a more energy dense nutrient) as a compensatory measure (Black, 1991, Gibney and Moloney, 1989). It may be that the removal of added sucrose and foods containing it from weight reducing diets has similar potential. If this tendency is reproduced, then the exclusion of added sucrose seems counterproductive. More research to examine this notion is thus, warranted.

1.4 Behavioural Aspects

It is important to understand the attitudes and beliefs which relate to the behaviour of eating certain foods, and how these vary within the populations if any impact is to be made in implementing dietary guidelines (Shepherd and Stockley, 1985). Compliance rates will be directly affected by the way obese individuals view, and give values to certain types of foods. This study aims to monitor and compare the dietary practices and beliefs of overweight individuals on weight reducing diets.

1.5 Methodological Considerations

This project will make use of estimated food record diaries. Many errors can occur in dietary assessment, and great care must be taken to minimise these. Before deciding to use a particular method of measuring dietary intake, research was carried out to look at the pros and cons of each methodology and consider their suitability for the main study.

Although it is appreciated that weighed food intakes are probably more accurate - they have their drawbacks. Livingstone et al (1990) reported suspiciously low energy intakes reported in 7 day weighed dietary records (as compared with Doubly Labelled Water Technique). The observed tendency for obese subjects to diet or underestimate intake during the measurement period was confirmed in this study. Prentice et al (1986) found similar results. Thus, although weighed intakes have been seen to be the most accurate, they are not the most valid, method of dietary assessment.

In view of the many other requests placed on the subjects it has been decided not to use weighed food records. A list of estimated food portions which are more likely to reflect normal dietary patterns, which could be clarified by interview, are thought to be more valuable than running the risk of unreported, unweighed foods.

Many researchers look on the use of estimated food records favourably. Edington et al (1989) compared estimated records with weighed intakes for individuals some 3-7 months apart. There would have been some variation due to weekly and seasonal variation. In view of this, correlation for total energy (0.74), protein (0.70), fat (0.80) and carbohydrate (0.84) was remarkably good. Todd et al (1983) found no difference in the mean protein and energy intake by weighing compared to food diary. Hackett et al (1983) used interviews after diary recordings to improve reliability. They suggested that diary and interview recorded more qualitative information than the food diary alone. This method is good at singling out the consumption of snacks, sweets and beverages which may be easily omitted from the diaries. Pearce et al (1981) echoed similar findings.

As the estimation of food portion sizes is the largest source of error in estimated food records, Bingham (1988), particular attention will be paid to determining and checking weights at the fortnightly interview. If possible individuals will weigh some foods.

The length of time over which food record diaries should be kept is a further point of discussion. The length of time should allow for fluctuations in habitual food intake, in that when results are averaged out, an accurate picture of average food intake is obtained. Some researchers believe that one week is as representative as any other week (Nelson 1983).

Doyle et al (1989) suggested that if dietary records can be satisfactorily collected over a period of less than 7 days the level of compliance should be increased.

Bingham et al (1988) shows the numbers of days of observation required for (the absolute magnitude of the average food consumption of an individual) with a precision of $\pm$ 10% standard error of the mean for various nutrients based on average daily variations. It can be seen that at this level of precision, a 7 day record is sufficient to measure only energy, carbohydrate and protein.

Observations do not need to be made over consecutive days. They can be split up into 3 or 4 day periods over the year and randomised to allow for weekends and seasonal variations.

TABLE 1

Number of days of observation required for an individual (Bingham et al, 1988).

Item	Average percent standard error* (SE) of a 7 day record.	Number of days* of records to be within 10% of the main intake.
Energy	9	5
CHO	9	6
Protein	10	7
Fat	12	10
Dietary fibre	12	10
Calcium	12	10
Iron	13	12
Thiamin	15	15
Riboflavin	17	19
Cholesterol	20	27
Vitamin C	23	36

* calculated from Balogh et al (1971).

24 hours recall will also be used to cross validate the food record diaries. The 24 hour recall method has several practical advantages. It is quick and simple to perform, places a minimal burden on the subject and is applicable to most target groups regardless of their background (Bingham et al, 1988). However, it is not without limitations. Day to day variation cannot be accounted for by this method, but since subjects are following a prescribed diet, it may be that variation is limited anyway, and is less difficult to recall.

A number of studies have measured the relative validity of the 24 hours recall. For group means it shows good agreement with estimated and weighed records (Bingham et al, 1988).

1.6 Hypothesis and Summary

The inclusion of sucrose containing foods in weight reducing diets increases compliance.

In summary, there is little supporting evidence for the removal of added sucrose and foods containing it from an energy reduced diet. The incorporation of small amounts of such foods in these diets, may increase palatability and convenience. The diet may be more acceptable and increase compliance.

2.0 METHOD

2.1 Overview

The sample for the study will comprise of volunteers from a large educational establishment. Subjects will be recruited by the researcher with the help of the Occupational Health Nurse.

Bulletins will be distributed to each department inviting individuals who have greater than 1 stone (7kg) in weight to lose, to join a free sliming programme, which will look at the palatability of weight reducing diets.

2.2 Selection of subjects

At a preliminary meeting individuals will be given further details about their involvement and will complete screening forms, to clarify their suitability for participation.

2.21 Criteria for selection will be:

- age 25-60 years;
- Body Mass Index (BMI) 26-35
- freedom from serious and chronic illness, which requires regular medical and/or dietary supervision;
- previous (but more than one year ago) attempts at dieting.

2.22 Other variables to be recorded:

- include age, gender, occupation, onset of obesity, and medication taken.

2.3 The diet sheets and evaluation of current intake.

2.31 The diet sheets.

Two isoenergetic reducing diets will be developed which contain quantifiable differences in foods containing added sucrose. Diet A (control) will be a traditional low fat, low added sucrose (providing 5% energy), weight reducing diet, and Diet B (experimental) will have equal calories but provide 10% energy from added sucrose, incorporated as sweet foods. The diet sheets will be divided into food groups and set allowances will be prescribed in the form of exchanges for each subject. The number of exchanges allowed will depend on the

subjects initial energy intake. A negative energy balance will be formulated to enable a weight loss of 0.5-1kg/(1-2lbs/wk), normally a deficit of 600kcals.

In the study, subjects will act as their own control and will be randomly allocated to either Diet A or Diet B for 8 weeks, at the end of which they will switch to the alternate diet for a further 8 weeks.

Key: *A1 = Subjects who follow diet A wks 1-8, B1 = Subjects who follow diet B wks 1-8.*
A2 = Subjects who follow diet A wks 9-16, B2 = Subjects who follow diet B wks 9-16.

2.32 Evaluation of current intake

Individuals still interested in the study will undertake a 24 hour recall. This will be carried out to estimate the subjects initial dietary intake, so that energy levels can be reduced sufficiently (by 600 kcals) to promote a weight loss of 0.5-1kg/(1-2lbs) per week. The interviews will take 15 minutes. Subjects will then be seen one week later and will be randomly allocated to either Diet A or Diet B.

2.4 Evaluation of prescribed dietary intake

2.41 Estimated dietary records with interview

Subjects will be requested to keep estimated food record diaries for 3 days, every 2 weeks for the whole 16 week programme. They will complete the diaries using descriptions of average household portions e.g. matchbox size of cheese, egg sized potatoes, a dessertspoonful, etc. When they return the diaries, subjects will be interviewed to clarify any discrepancies in the diaries, or problems in recording portions.

All subjects will be given a record booklet with clear instructions on recording procedure. Guidelines in determining the weights of foods and describing food times will be included in the booklet. An example of one day's recorded intake will be given to aid comprehension **(see appendix)**. The 12 days to be recorded will include weekend days. The food record diaries will be piloted.

2.42 24 hour recall

At each fortnightly meeting subjects will also undertake a 24 hour recall. This will be used to cross validate the 3 day diaries.

They will not be informed when the recall will take place, but it will be incorporated into the interview situation every fortnight. Food record diaries will be collected in first.

2.5 Two week progress report

At each fortnightly interview, index cards will be kept noting down general progress, problems, and any external circumstances which may have influenced compliance rates.

For example:

- holidays,
- emotional problems,
- illness etc.

2.6 Anthropometry

2.61 Weight

The subjects weight will be recorded every 2 weeks. Current weight will be measured using calibrated Salter scales. The scales will be checked regularly against dead weights. The scales must be positioned on a hard floor and subjects must be weighed without shoes and in light clothing to an accuracy of +/- 0.5g. Subjects will be requested to empty their bladder before weighing and as far as possible will be weighed at a similar time on each occasion.

2.62 Height

Height will be measured using a metre rule positioned on the wall.

2.63 Body Mass Index (BMI)

BMI will be calculated using the following equation:

$$BMI = \frac{\text{Weight (kg)}}{\text{Height (m)}^2}$$

(measured in indoor clothing).

2.64 Pilots

The diet sheets and food record diaries will be piloted on 2 slimming groups, to see if they are comprehensive, and easy to follow.

2.7 Data Analysis.

2.71 Initial 24 hour recall and food record diaries.

COMP-EAT 3 will be used to analyse the initial 24 hour recalls and the food record diaries. However, since this data base is unable to analyse the sucrose content of foods, these will be calculated manually from data obtained from the Dunn Clinical Nutrition Centre, Cambridge.

2.72 SPSS/PC+ Analysis.

SPSS/PC+ will be used to analyse weight loss and for the analysis of fortnightly nutrient intakes of energy, fat carbohydrate and sucrose on both diet A and diet B. Simple statistics will be undertaken.

2.8 Timetable

The study will take place over a three month period, and planned to avoid major holidays.

3.0 RESULTS

3.1 Characteristics of a sample.

3.1.1 Number of Subjects

A total of 27 individuals volunteered and of these 21 commenced the programme. Out of the 21 who started, 17 completed the study. All subjects were recruited from staff at a large educational establishment in Edinburgh. A total of 9 visits were made by the researcher.

3.1.2 TABLE 2 - Gender of Total Subjects of the Sample Group (n=27).

Sex	Number of Subjects
Male	6 (22)
Female	21 (78)

percentages in brackets

Of the 27 subjects recruited, 21 were female and 6 were male.

3.13 Age

TABLE 3: Age Range of Total Subjects (n=27).

Age Range (yrs)	25-30	31-40	41-50	51-60	61-65
Number of Subjects	3 (11)	5 (19)	9 (33)	8 (30)	2 (7)

percentages in brackets.

The mean age was 45 years. Ages ranged from between 25 to 62 years old.

3.14 TABLE 4: Occupation of Subjects (n=27).

Administrative	Academic	Other
19 (70)	6 (22)	2 (8)

Percentages in brackets

The subjects were mainly administrative or teaching staff (with the exception of one recruit, who was a maintenance worker and the occupational health nurse also took part).

3.15 TABLE 5: Initial weight and duration of this present weight of total subjects (n=27)

Initial weight (kg)	Duration of present weight (years)
77.9	3
68.8	1
81.5	3
120.4	27
79.7	4
85.1	37
66.5	2
67.8	1
69.7	3
85.6	0.5
79.2	missing value
79.2	5
67.4	2
77.0	3
72.9	9
55.2	10
57.0	1
64.7	5
95.1	missing value
77.0	5
77.9	23
64.3	2
85.1	5
53.9	2
73.3	0.5
98.7	36
69.7	2

3.16 TABLE 6: Initial weight, height and body mass index of total subjects.

	No. subjects	Mean	s.d
Initial weight (kg)	27	75.9	13.7
Height (cm)	27	163	8.4
BMI (kg/m^2)	23	29	2.6
Duration of initial weight (years)	25	7.5	10.6

Initial weight ranged between 53.9kg to 120.4kg with a mean of 75.9kg.
Some of the subjects had been at their present weight for many years, others for only a few months, (range 0.5-37 yrs), with a mean of 7.6 years. Heights ranged from 150-180cm with a mean of 163cm. Figures for height and initial weight were used to calculate Body Mass Index which ranged from between 25 to 46 with a mean of 29.

3.2 Preliminary pilots

The 2 pilot groups chosen were a group of old age pensioners who had been referred to a health centre for weight reducing advice; and the other sample were low income volunteers who attended a slimming group organised by a social worker. Diet sheets and food record diaries were piloted to see if they were easy to understand and follow and that the diets promoted weight loss. The diet sheets and diaries were then used in the present pilot study.

3.21 Diet sheets

There were no major problems in understanding the diet sheets, or with the layout of them, reported in the pilot studies. Subjects found them to be comprehensive and easy to follow.

3.22 Food record diaries

Subjects found the instructions in the diaries straight forward and easy to understand. However, there were some discrepancies in portion sizes, which were usually clarified at the interview when the diaries were collected. The use of food models and/or photographs would have been useful, and should be used in future.

3.3 Weight loss

3.31 TABLE 7: Mean weight loss on diet A compared with diet B for those 21 subjects who completed the diets.

Key: *A1= Subjects who followed diet A wks 1-8, B1= Subjects who followed diet B wks 1-8.*
A2 = Subjects who followed diet A wks 9-16, B2 = Subjects who followed diet B wks 9-16.

	Group A1 (LSD)	Group B1 (SCD)
Initial weight (kg)	80.0	71.5
Weight loss week 8 (kg)	3.3	2.5
	Group B2 (LSD)	Group A2 (SCD)
Weight loss week 16 (kg)	1.2	1.2
Total weight loss (kg):	LSD	SCD
	4.5	3.7

Of the 12 subjects who commenced diet A for the initial 8 weeks, 11 subjects lost weight, and 1 subject gained. Mean weight loss was 3.3kg, with a range between 0.4kg-6.3kg. Of the 9 subjects following diet A for the second 8 weeks, only 6 actually completed. Of these

3 lost weight, 1 subject the same weight, and 2 subjects gained weight. Weight loss remained between 0.4-6.7kg (a mean of 1.2kg). The mean total weight loss of subjects following diet A was 4.5kg.

Of the 9 subjects who followed diet B for the first 8 weeks, 7 lost weight and 2 gained weight. Weight loss ranged from between 0.4-6.7kg with a mean loss of 2.5kg. Of the 12 subjects following diet B for the second 8 weeks, 1 dropped out, and of the 11, 9 lost weight and 2 gained. The range of weight loss was between 0.9-3.1kg with a mean loss of 1.2kg. The mean weight loss of all subjects following diet B was 3.7kg.

3.4 TABLE 8: Percentage energy from added sucrose, fat and carbohydrate at initial intake and on diets A & B.

	No. subjects	Range %	Mean %	s.d
% E from added sucrose:				
Initial	21	0-18	6.3	4.5
Diet A	18	0-6.1	2.7	1.8
Diet B	15	0.5-18	8.7	4.9
% E from fat:				
Initial	21	22-50	37	8.1
Diet A	18	22-42	31	6.3
Diet B	15	20-41	29	6.2
% E from cho:				
Initial	21	33-59	44	7.2
Diet A	18	27-59	48	8.4
Diet B	15	41-59	50	5.3

N.B. The figures for carbohydrate include added sucrose.

3.4 Percentage energy from added sucrose, fat and carbohydrate, initially and on both diets.

The percentage energy from added sucrose, fat and carbohydrate was observed at 3 stages - initial intake (baseline) and after following diet A and diet B. Added sucrose levels at baseline ranged from between 0-8% with a mean of 6.3%. On diet A intake dropped to 2.7% and on diet B rose to above the initial intake in most subjects - between 0.5-17.6% with a mean of 8.7%. Not all subjects were able to adhere to the prescribed amounts of added sucrose as shown by the range in percentage energy on both diets. Some of those following diet A were seen to exceed recommendations to keep their added sucrose levels

below 5% (the highest amount being 6.1%). Some of those following diet B preferred to consume less than the prescribed 10%, whilst others ate more (range 0.5-18%).

The mean percentage energy provided by baseline fat was 37.2%. On diet A it dropped to a mean intake of 30.7%, and on diet B to 29%.

The percentage energy from carbohydrate at baseline was 44.4%. On diet A carbohydrate intake provided 47.9% and on diet B, 50.4%. The inclusion of added sucrose increased the total carbohydrate content of diet B.

3.41 TABLE 9: Grams added sucrose, fat and carbohydrate, initially and on diets A and B.

	No. Subjects	Range (g)	Mean (g)	s.d.
Added sucrose(g)				
Initial	21	0-98	35	25
Diet A	18	0-24	8	6
Diet B	15	1-68	29	20
Fat (g)				
Initial	21	45-133	91	25
Diet A	18	24-63	43	12
Diet B	15	18-66	41	14
Carbohydrate (g)				
Initial	21	177-357	241	47
Diet A	18	52-254	152	50
Diet B	15	81-270	160	50

Actual grams of added sucrose, fat and carbohydrate were recorded. The results are summarized in Table 9. Initial added sucrose intakes ranged from 0 to 98g per day with a mean of 34.5g. Most people were seen to include added sucrose in their diets. On diet A mean added sucrose intakes dropped to 8.3g, with a range of 0-24g. On diet B sucrose intake ranged from between 1-68g with a mean of 29.3g.

Initial grams of fat ranged from between 45-133g with a mean intake of 90.8g. There was a significant drop in fat on diet A, with a range of 24-63g and a mean of 42.5g. On diet B fat intake ranged between 18 and 66g with a mean of 40.8g (less than on diet A).

Carbohydrate intake at baseline ranged between 177g-357g with a mean of 241g. On diet A the intake ranged from 52-254g with a mean of 152g; and on diet B CHO intake ranged from 81-270g with a mean of 159g.

3.42 TABLE 10: Mean energy intake - initial compared with diet A and diet B.

Weeks	Total subjects initial intake (kcals)	Intake Diet A (kcals)	Intake Diet B (kcals)
Initial	2189 n=21	2,139 n=12	2,257 n=9
Week 2 (kcals)		Diet A1 n=12 1,240	Diet B1 n=6 1,150
Week 8 (kcals)		Diet A1 n=12 1,390	Diet B1 n=6 1,523
Week 10 (kcals)		Diet A2 n=6 1,288	Diet B2 n=9 1,322
Week 16 (kcals)		Diet A2 n=5 1,305	Diet B2 n=8 1,628

n=Number of diaries collected/analysed for these weeks.

Above is a summary of mean intakes for initial energy and reported energy on diets A and B at weeks 2, 8, 10 and 16. Subjects on diet A for the first 8 weeks had substantially reduced their energy intake to a mean of 1,240 kilocalories at week 2, and slightly increased intake upto 1,390 kilocalories at week 8. Subjects on diet B for the first 8 weeks, however, had a mean intake of 1,150 kilocalories at 2 weeks on the diet, but this figure rose to 1,523 kilocalories by week 8.

Those subjects who were on diet A between weeks 9-16 were seen to have a mean intake of 1,288 kilocalories at week 10, which rose slightly to 1,305 kilocalories by week 16. On diet B, however, (weeks 9-16) the mean reported intake was higher at 1,322 kilocalories (week 10) rising to 1,628 kilocalories at week 16.

3.5 Dropouts

TABLE 11: Subjects commencing the programme

	Number
Total volunteers recruited	27 (100)
Volunteers commencing the diet.	21 (78)

*Percentage in brackets.

Of the 27 initial volunteers, only 21 subjects actually commenced the diets. This was for a number of reasons. Some did not fit the selection criteria, others were away on holiday, and some just had second thoughts about dieting.

TABLE 12: **Subjects completing the programme**

	Start	Completed
Diet A		
weeks 1-8	12	12 (100)
weeks 9-16	9	6 (67)
Diet B		
weeks 1-8	9	9 (100)
weeks 9-16	12	11 (92)

*Percentage in brackets.

All subjects who were on diets A and B for the initial 8 weeks completed the first half of the programme. Of those 12 who went on diet B, weeks 9-16, only 11 followed the diets through to week 16. Of those 9 who were on diet A between weeks 9-16, only 6 completed.

The subject who dropped out from diet B (weeks 9-16) did so through illness. The dropouts on diet A during this period either found the diet too limiting (missed foods containing added sucrose) or had actually reached a weight they were happy with and did not want to diet further.

3.6 Data analysis

Analyses of recall and diaries was initially carried out using COMP-EAT 3. However, this procedure took up to 60 minutes per diary and for 189 recordings this was found to take too long. Thus, a food scoring system was developed from data obtained from 'The Royal Society of Chemistry' (McCance and Widdowson, 1992) and COMP-EAT 3 analysis package (Nutrition Systems). Added sucrose values were obtained from data provided by the Dunn Clinical Nutrition Centre. The scoring system was found to significantly reduce analysis to about 20 minutes. Excellent correlation coefficients were achieved when comparing this method with 24 hour recalls and diaries analysed by COMP-EAT 3 (see **appendix**). This system was adopted for the calculation of the rest of the diaries.

SPSS/PC Analysis

A definition file incorporating a data list, missing values, variable labels and value labels was created and a data file was composed into which was fed the raw data. It took about 12 hours to key in the data, and for this task an assistant was employed. The entered data was then checked by the researcher.

3.7 Food record diary response

The return of food record diaries each fortnight was variable. Some individuals who were highly motivated returned their diary every two weeks. Others needed constant reminding and external factors such as holidays, family celebrations or emotional reasons influenced their completion and return.

Table 13: Number of food record diaries completed by the 21 subjects who commenced the programme

Subjects	Wk 2	Wk 4	Wk 6	Wk 8	Subjects	Wk 10	Wk 12	Wk 14	Wk 16
12	12 (100)	7 (58)	9 (75)	12 (100) x =10	11	8 (67)	6 (50)	6 (50)	9 (75) x=7
9	6 (67)	7 (78)	9 (100)	7 (78) x=7	7	5 (56)	6 (67)	4 (45)	5 (56) x=5

Percentage in brackets.

Table 13 summarises the food record diary response. The fortnightly response seemed better in the initial 8 weeks for subjects on both diets A and B, with a mean response of 10 (out of 12) diaries and 7 (out of 9) respectively, this is compared with a mean response of 7 (out of 11) diaries, on diet A, and a mean response of 5 diaries (out of 7) on diet B during the final 8 weeks (weeks 9-16).

4.0 DISCUSSION

4.1 Dietary methodology and diet sheets

4.11 Choice and limitations of the method of measuring dietary intake

Introduction

"The measurement of habitual food intake of an individual must be among the most difficult task a physiologist can undertake" (Garrow 1974).

Many errors occur in dietary assessment and great care must be taken to minimise these. Before deciding on a particular method much background research was carried out to look at the advantages and disadvantages of each methodology and consider their suitability for the present study.

The table below illustrates the errors to be found in the different types of dietary research methodology.

TABLE 18: Errors to be found in the different types of dietary research methodology.

Sources of error	Records with weights	Records with estimated weights	Daily recalls	Diet histories and q'aires
Food tables	+	+	+	+
Coding errors	+	+	+	+
Wrong weight of foods	-	+	+	+
Reporting error	-	-	+	+
Variation in time.	+	+	+	-
Wrong frequency of consumption	-	-	-	-
Change in diet	±	±	-	-
Response bias	±	±	±	±
Sampling bias	+	+	+	+

+ Errors to be present ± Errors may be present - Errors not present. (Bingham et al, 1985)

Estimated food records were chosen for this study. Although weighed food intakes are associated with the least errors and are generally thought to be most accurate, there are

problems with their use (see section 1.5) which made them inappropriate for this study. These include inconvenience, underestimating intake (Prentice et al, 1986), unreported foods, and altering intake to impress the researcher (Trulson and McCann, 1959). The study thus, questioned whether accurate measurements of weighed food records, which ran the high risk of unreported, unweighed foods were preferable to a list of estimated portion sizes which were more likely to reflect normal dietary patterns and intakes (though less accurate in weight). Portions could then be clarified by interview. This latter option worked well, and other researchers have also reported favourable results (see section 1.5) including Hackett et al (1983).

The main advantages of the estimated food diary are that it requires less subject motivation than the weighed method and doesn't simply rely on memory. "Cooperation rates are likely to be higher than for weighed surveys, especially over long recording periods" (Nelson and Nettleton, 1980).

4.12 Discussion on methodology

The subjects in the study found the diaries very comprehensive and easy to use. They particularly found the instructions at the beginning and the example of how to fill them in helpful. However, there were some discrepancies in portion sizes, which were usually clarified at interview (Hackett et al, 1983) when the diaries were collected.

In some instances the occasional weighing of foods may also give the subjects a better idea of standard amounts to help identify the weights of foods that are eaten regularly. This practice was recommended, but in further studies demonstrations by the researcher may help clarify portion sizes at interview sessions.

The return of food record diaries every fortnight was variable. Some subjects who were highly motivated returned their diary every 2 weeks. Others needed constant reminding, and external factors such as holidays, family celebrations or emotional reasons influenced their completion and return. It would be useful practice in further studies to be able to telephone the subjects before they were due to complete the diaries to remind them that they must do this.

4.13 Diet Sheets

Piloting the diet sheets and general instructions

There were no major problems with subjects understanding or following the diet sheets. The only alteration recommended would be to make the diet sheets smaller in a booklet form (as opposed to their A4 size).

Since subjects were a little unclear about the details of their involvement in the study it would be a good idea to present them with a booklet of instructions/guidelines explaining what was expected of them and include a programme of events. Also subjects would benefit if they had their own personal record card of weight loss.

4.2 Number of Subjects

Of the 27 people who volunteered initially for the study only 21 actually commenced the diets and 17 finished the whole programme. Unfortunately the distribution of subjects commencing diets A and B was slightly unequal. This was because subjects dropped out of the study after being given the diet sheets, for circumstances including illness, holidays and lack of commitment for the 16 week period. As well as there being less subjects on diet B (9 compared with 12 on diet A) during weeks 1-8, the distribution of initial weight was higher on diet A than diet B. The rate of weight loss would be expected to be faster in the group with the most weight to lose (Garrow 1991). This was seen to be the case (see section 4.4).

It is important in subsequent studies to ensure that equal numbers commence each diet and that weight distribution is also equal on each diet. It is intended in the main study to increase numbers sufficiently so that results are of more statistical significance.

4.3 Body Mass Index (BMI)

The selection criteria stipulated that BMI should be between 26 and 35 to ensure that subjects had sufficient excess fat stores to accommodate a weight loss of 0.5-1kg per week over the 16 week period. However, some subjects (4) had a BMI less than this (24-25). They had some weight to lose but not sufficient to continue until the end of the study. They did commence the diets however, and set themselves a target weight. When they had lost half of the amount of weight they needed to achieve their target, they switched to the alternate diet.

For the main study however, it must be stressed that subjects should fall within the recommended BMI selection criteria.

4.4 Weight Loss

Weight loss occurred on both diet A and diet B over the 16 weeks. It would appear that the mean weight loss on diet A (4.5kg) overall, was greater than mean weight loss on diet B (3.7kg).

However, initial weight was greater in the 12 subjects who followed diet A between weeks 1-8 than the 9 subjects who commenced diet B during this period. More weight is lost in the initial stages of dieting. A more rapid weight loss would be expected from those who had more weight to lose initially (Gilbert and Garrow, 1983, Stein et al, 1981 and Krotkiewski 1977).

Garrow (1991) states that for the first month of dieting the rate of weight loss is more rapid due to the glycogen/water effect (1g glycogen binds with about 3g water), so that glycogen loss is accompanied by a corresponding loss of water (and of weight) in excess of the amount expected, on the basis of 1kg being equivalent to 7000 kcals. Also with substantial weight loss, metabolic rate is reduced, so that on a given diet the energy deficit is reduced and weight loss becomes slower (Garrow, 1991). Thus, weight loss on both diets was seen to be more rapid during the first 8 weeks (mean weight loss 3.3kg on diet A and mean weight loss 2.5kg on diet B) than in the last 8 weeks (mean weight loss diet A2, 1.2kg and mean weight loss diet B2, 1.2kg).

However, it is encouraging to see that weight loss did occur, even though at a slower rate on Diet B. It would be interesting to compare whether those who finished the programme on Diet A or B actually maintained their weight loss, since achieving the desired weight loss does not mean the end of dietary efforts. Difficulties often arise as a result of lowered energy requirements and a new eating pattern needs to be learned to match these (Thomas, 1988) after the diets have finished. Since diet B allowed subjects to have a similar percentage energy from added sucrose to that of baseline, it may be that they find it easier to adapt it as a maintenance programme than diet A (which in severely reducing added sucrose was perhaps more restrictive). Diet A being more limiting may be harder to modify for longer periods and it may be that subjects over eat foods they have been denied after the dieting period has finished. Thus, yo-yo weight cycling and weight gain may result. "The obvious reason for weight regain after weight loss treatment is that participants return to inappropriate eating habits. These habits need not be as bad as pretreatment habits to cause regain, because metabolic factors make it easier to regain after a period of dietary restriction" (Blackburn et al, 1989).

Whatever the amount of weight loss it is apparent that it occurred on both diets, but not at the same rate. Thus, if weight loss is seen to occur on a reducing diet that allows food containing added sucrose, why do therapeutic diets perpetuate the exclusion of these? It may be that by incorporating small amounts of added sucrose in weight reducing diets, they become easier to follow. Compliance rates are thus, improved and weight loss promoted.

Before stating that weight loss reflects compliance, it is important to examine whether the subjects have been following the prescribed diets carefully.

4.5 Dietary Compliance

In this study compliance was measured by:

(i) weight loss

(ii) dietary intake, as measured by diary recordings.

Compliance when measured in terms of weight loss was variable (see section 4.4). Although generally subjects were seen to lose more weight on diet A, weight loss did occur on both regimes. Some individuals were successful and some were not, on both diets. This

seemed to be independent of whichever diet they were on (i.e. composition of diet), since if they had stuck to the diets as directed, weight loss should have occurred equally on both. The design of the diets ensure that if followed correctly equal weight loss should ensue. An optimum of 0.5-1kg per week, which represents an energy deficit of 500-1000 kcals/day (Garrow 1991) would be lost. It seems that compliance rates as measured by dietary intake was more dependent on the individual's personality, motivation (Feinstein 1960), and attitudes and beliefs about weight reducing diets and foods containing added sucrose within therapeutic diets. This information was elicited from the informal record cards kept every week, and from general statements expressing guilt about eating sucrose containing foods, on either of the diets or by peer pressure to stop. Also motivational factors were observed at fortnightly interviews on an informal basis. Subjects would openly admit that they couldn't be bothered dieting any more or had been cheating.

Since attitudes and beliefs significantly affect food choice (Shepherd 1989 and Tuorila 1987) they need to be given due consideration and differentiated from the added sucrose variable as separate determinants of compliance. For example, some individuals had great faith in weight reducing diets and were highly motivated, whereas others didn't particularly take the diets seriously, but went on them, 'for fun'. If they lost weight then that was a bonus. Other subjects believed that consuming added sucrose and foods containing it would maintain obesity and should not be included in a reducing diet. They were thus, reluctant to incorporate added sucrose exchanges into their diet and as such compliance rates were affected. External pressures from non-dieting peers to cut out foods that contained sucrose also reinforced negative feelings about having them in reducing diets. The fact that subjects were self volunteered, many not needing to lose that much weight, (often only for cosmetic reasons) meant that motivation may not have been as high as it would have been if the need to lose weight were for health benefits.

It is very important to understand the attitudes and beliefs which relate to the behaviour of eating foods containing added sucrose (and behind being on weight reducing diet in general) and how these vary within the populations, if any impact is to be made in increasing this type of carbohydrate in the diet. It is, therefore, of interest to understand eating behaviours in obese individuals and relate these to dietary compliance in future studies. There are a number of standardised and validated psychological scales which have been developed to

measure attitudes and beliefs. Ajzen and Fishbein's (1980) Theory of Reasoned Action, is one of these and would be particularly useful to elicit such information in the study proper.

4.51 Reasons for success/failure of weight loss

Compliance with diet may be different to compliance as measured by weight loss. In this study some people reduced their energy intake below that which had been prescribed and achieved impressive weight loss. However, what may be noted as a success through monitoring weight loss could be seen as a failure in terms of dietary compliance. For example, when looking at solely weight loss:

Success could be due to:

either

(i) Individuals complying with regimes and losing weight without problems.

or

(ii) Individuals not complying with regimes, but instead turning to self prescribed, very restrictive diets of less than 1000 kcals. They did not follow the recommended exchanges, and generally fell below prescribed amounts on both diets. This was undesirable. The energy deficits were greater than 1000 kilocalories/day. The problems with this are that there may be excessive loss of lean tissue, difficulties in providing essential nutrients, and there may have to be further larger adjustments at the end of the dieting period to achieve weight maintenance (Garrow 1991).

The question then is what should be the measure of compliance? If the dietitian is said to be effective in providing advice, but the patient 'makes up' their own programme, is this desirable? Conversely .....

Failure could be due to:

either:

(i) Cheaters - who did not comply with the diets and did not lose weight (or very little). Some recorded that they had cheated, others did not.

or:

(ii) Subjects who really didn't want to lose weight or who were very complacent about losing it, despite indicating that they did. It would be interesting to measure an individual's intention to lose weight and follow a diet, compared with their actual outcome. The Ajzen and Fishbein (1980) Theory of Reasoned Action, could be used in future studies to monitor this.

IT IS, THEREFORE, CLEAR THAT, COMPLIANCE WITH DIET MAY BE DIFFERENT TO COMPLIANCE AS MEASURED BY WEIGHT LOSS.

4.52 Foods containing added sucrose

Foods containing added sucrose in diet B were received differently. Some individuals couldn't overcome traditional beliefs that these foods should be excluded. Intervention to review subjects attitudes and beliefs about including such foods in reducing diets is important before any impact can be made in prescribing added sucrose for them.

(b) Some subjects reported that once they started eating tempting foods which contained added sucrose, they couldn't stop. This would support the view that "obese individuals prefer sweet tasting substances in higher quantities than normal weight individuals and that they are particularly unable to restrain themselves in the face of tempting foods" (Wurtman et al 1981 and Yudkin 1973). However, other researchers argue that no differences or a lower sweet preference for obese subjects compared with normal weight ones occur (Malcolm et al 1980).

Some subjects weren't keen on foods which incorporated added sucrose, because they did not have a sweet tooth and would not have included them in their diets normally. Popular beliefs aside, there is little direct evidence that the diet of obese individuals is rich in sweetened foods (Drewnowski 1991). On the contrary epidemiological surveys of different populations observed an inverse relationship between reported sugar consumption and the

degree of overweight. One large scale British Study (Keen et al 1979) reported a negative correlation between body weight and total energy, total carbohydrate and sucrose intake. A nationwide survey of almost 1,000 US children and adolescents (5-18 years) found no significant relationship between body fatness and self reported intakes of sugar and other snack-type foods (Morgan et al 1983). Walker (1977) and West (1978) show that the risk of diabetes is inversely related to carbohydrate and sugar consumption and positively related to fat consumption and total calories (Bierman 1979). Since obesity is the chief risk factor for adult onset diabetes, it may be that obese individuals overeat, not sugar, but fat (Gonzales 1983). Subjects who did not comply with diet B because they disliked sweet foods but preferred savoury, often high fat/fried foods, may have had their initial weight problem because of this. If they could learn to switch preferences for savoury, high fat foods, to a more carbohydrate rich diet, which included items that contained added sucrose, then weight loss may increase, and if this practice was continued after dieting, weight maintenance might be promoted.

4.53 Intake as Reflected by Estimated Record Diaries.

From the diaries collected for weeks 2 and 8 on diets A and B it was apparent that energy intake was significantly reduced compared with initial intake. Weight loss on both diets was thus, observed. However, energy intake on diet A was found to be less than on diet B, but at week 8 on both diets mean energy intakes rose (1,390kcals on diet A and 1,523kcals on diet B). This may be because after the first few weeks dieters become less conscientious about keeping to the diet (Garrow 1991). This can be demonstrated if dieters who have a weight 'plateau' are admitted to a metabolic word where the diet is strictly calculated, weight loss immediately restarts (Garrow 1988).

After switching over to the alternate diet, at week 10 energy intake was higher for those on diet B2 (mean intake 1,322 kcals) and only 1,288 kcals for those on diet A2. This may be because after the initial 8 weeks of dieting subjects were less conscientious. Mean energy intake continued to rise and by week 16 intakes of 1,305kcals (A2) and 1,628kcals (B2) were recorded.

This trend in energy increase was not necessarily reflected in added sucrose consumption overall. Initial intake of added sucrose (total 21 subjects) expressed as percent energy showed a mean of 6.3% with a range between 0-18%. On diet A1 (Weeks 1-8) average

sucrose intake was between 0-6.1% with a mean of 2.7%; energy from added sucrose. Some subjects on this diet were found to exceed recommendations of 5% energy from added sucrose, finding it difficult to adhere to such low amounts. On diet B1 (weeks 1-8), added sucrose intake expressed as percent energy ranged from between 0.5-18% (which was similar to baseline intake) with a mean of 8.7%. Some people on this diet did not always use all of the recommended 15g exchanges and as such, they did not comply. They seemed to like the option of being able to incorporate some foods with added sucrose in their diet, but did not necessarily want their whole prescription. A few found it difficult to stop eating added sucrose exchanges once they started which accounted for the higher end of the range.

Results indicating that 0g added sucrose was consumed must be questioned. This may have been a reflection of poor record keeping. Subjects may have felt guilty about deviating from their diets and including added sucrose especially on diet A. Even on diet B some subjects were not convinced that foods incorporating added sucrose were allowed in weight reducing diets. They therefore, reported very restrictive, sucrose free regimes. Another possibility of obtaining 0 grams for sucrose would be inadequate information on the sucrose content of foods, used by the researcher. Data obtained from the Dunn Nutrition Centre only focused on foods with added sucrose in the ingredients. The naturally occurring sucrose content of foods, therefore, was unable to be analysed and as such although the figures for sucrose may be very low they would not be expected to be zero.

Fat intake (weeks 1-8) were also seen to be reduced considerably compared with initial intake for the total subjects (mean 90.8g, 44%), on both diet A (mean 42.5g, 30.7%) and diet B (mean 40.8g, 27.3%). Diet B had marginally less fat in the diet than diet A, which may be due to the inverse relationship between carbohydrate and fat (Black, 1991) but further research is needed to confirm this.

Total carbohydrate intakes were similar on diet A (152g, providing 47.9% energy) and diet B (159g, providing 50.4% energy) since the complex carbohydrate deficit on diet B was made up with added sucrose exchanges.

4.6 Dietary Analysis

An assistant was employed to key in raw data. The researcher then checked the entered data. It was found to be difficult to both enter and check data from piles of documents and would in future studies be much easier to record the raw data on a large record card for this purpose.

4.7 Recommendations and Summary

From this pilot study compliance when measured in terms of weight loss and by food record diaries was seen to be variable. However, subjects did lose weight on both diets, although at a slightly slower rate on diet B. This may not have been due to the composition of the diets, but other external influences, for example, subjects had less initial weight to lose on diet B making weight loss slower and also the attitudes and beliefs about being on a diet which included added sucrose. However, the fact that weight loss was observed on a diet which included these foods and that it was at a steady rate was encouraging. It would be interesting to follow up subjects who ended the programme on diet A and diet B, and observe after 1 month, 3 and 6 months, which group had maintained their weight loss.

Recommendations for a further study should consider the following:

(1) It is important to recruit a larger sample to ensure equal numbers commence both diets and that results are of statistical significance and that subjects are allocated to groups such that weights are matched.

(2) Provisions should be made to measure attitudes and beliefs about dieting and following weight reducing diets in which foods containing added sucrose are included. Since attitudes and beliefs significantly affect food choice (Shepherd 1989) they need to be given due consideration as determinants of compliance.

Foods containing added sucrose were received in different ways by subjects. Some people found it difficult to accept that these foods could have a role in weight reducing diets and found it hard to overcome traditional beliefs. A questionnaire on attitudes and beliefs in the next study could measure subjects opinions about it's inclusion. The Ajzen and Fishbein (1980) Theory of Reasoned Action would be a preferable model. Only when attitudes and beliefs are measured can they be changed.

(3) Weight loss was observed in subjects who complied with the regime, but also with individuals who did not necessarily comply with the prescribed diet. Some subjects were found to self prescribe very restrictive diets to ensure rapid weight loss. This was not ideal since lean body mass would be lost and other nutrients deprived.

Those individuals who failed to lose weight or simply maintained weight either cheated and exceeded prescribed amounts because they were either complacent about following a weight reducing diet or found it difficult to adhere to the diets despite wanting to achieve weight loss.

It must be emphasised in future studies that weight loss will occur but only if prescribed amounts are adhered to. A booklet reminding subjects that they must stick to recommended amounts, which also informs them about their involvement in the study, would be a useful reinforcement.

Other subjects found difficulty in restraining themselves, and once they started eating added sucrose containing foods they said that they found it difficult to stop. However, others were quite disciplined and liked having the option of including these foods in their diet. Some subjects on diet A could not stay within the recommendations of an added sucrose allowance which provided 5% of the daily energy.

(4) The return of the food record diaries could have been better. Some subjects returned them every week but most needed reminding. In the next study it would be a good idea to telephone subjects before they are meant to fill in the diaries to remind them.

(5) A standard method of recording social/emotional circumstances which may have affected compliance is recommended. Index cards were used to record events for example, holidays and illness, or emotional circumstances which caused subjects to deviate from their diets. However, the data was not quantifiable in the pilot study and more standard questions need to be drawn up to elicit this response. A brief questionnaire about how subjects feel when they are following each diet (for example, they may feel good if they have followed the diet, or guilty if they have cheated) would indicate the subjects moods from day to day on the diet.

(6) Also subjects must fall within the recommended Body Mass Index so that at the rate of (0.5kg-lkg)/day they have sufficient weight to lose over the dieting period.

(7) Data would be better entered into the computer from a large record card, rather than simply from piles of data. This would minimize the risk of error and make it easier for the researcher to check.

APPENDIX (PILOT STUDY).

VALIDATION OF FOOD SCORING SYSTEM

24 HOUR RECALL ANALYSIS

A sample of ten 24 hour recalls were analysed using Compeat 3.This was found to be very time consuming and as such would not be an ideal method of calculating the numerous recalls and food record diaries that would be collected over the 16 week programme. A quicker food scoring system was devised based on the American and Canadian systems to calculate total energy, carbohydrate, and fat intakes. This system was validated by analysing the recalls using Compeat 3 and comparing them with recalls analysed using the food scoring tables just mentioned

Energy, Fat and Carbohydrate Intakes Analysed Using Compeat 3 Compared With Those Analysed with Food Tables developed by the Researcher.

Nutrient and Type of Analysis	No. Recalls	Mean	Standard Deviation
energy wd Compeat 3	10	2034.20	263.63
energy wd Food Tables	10	2003.90	218.04
energy we Compeat 3.	10	2459.10	528.20
energy we Food Tables	10	2408.00	467.82
fat wd Compeat 3	10	78.280	26.081
fat wd Food Tables	10	77.700	21.345

Nutrient and Type of Analysis	No. Recalls	Mean	Standard Deviation
fat we Compeat 3	10	103.570	39.005
fat we Food Tables	10	102.400	40.602
carbohydrate wd Compeat 3	10	242.180	39.928
carbohydrate wd Food Tables	10	239.300	41.781
carbohydrate we Compeat 3	10	260.060	50.174
carbohydrate we Compeat 3	10	252.350	36.602

Key

wd = weekday

we = weekend

Linear Correlation (Pearson's r)

Correlation weekday energy - Compeat 3 vs Food Tables = 0.888

Correlation weekend energy - Compeat 3 vs Food Tables = 0.968

Correlation weekday fat - Compeat 3 vs Food Tables = 0.827

Correlation weekend fat - Compeat 3 vs Food Tables = 0.952

Correlation weekday carbohydrate - Compeat 3 vs Food Tables = 0.880

Correlation weekend carbohydrate - Compeat 3 vs Food Tables = 0.901

Measurement of Strength of Agreement - Intraclass Correlation Coefficient

Energy wd Compeat 3 vs Food Tables R = 0.855

Energy we Compeat 3 vs Food Tables R = 0.900

Fat wd Compeat 3 vs Food Tables R = 0.994

Fat we Compeat 3 vs Food Tables R = 0.991

Carbohydrate wd Compeat 3 vs Food Tables R = 0.952

Carbohydrate we Compeat 3 vs Food Tables R = 0.733

Calibration of Weighing Scales

Standard Weights (kg)	Salter Scales (kg)
5	4.9
10	9.9
15	14.9
20	19.9
25	25
30	30.3
35	35.6
40	40.4
45	45.4
50	50.5

APPENDIX VII

Food Scoring System

Based on McCance and Widdowson's:

The Composition of Foods (1992).

	Weight (g)	Energy (kcal)	Fat (g)	Carbohydrate (g)	Sucrose (g)
BREAD					
Brown Bread (2)	70	153	1.4	31	0
White Bread (2)	75	176	1.4	37	0
Bread Roll (1)	55	147	2.1	28.5	0
CEREALS					
Weetabix (2)	40	142	0.8	31.3	0
All Bran	45	113	1.5	19.4	5.2
Bran Flakes	45	144	0.9	31.4	6.7
Corn Flakes	25	89	0.2	21.2	1.7
Crunchy Nut Cornflakes	45	179	1.8	39.9	19
Porridge with Water	160	78	1.8	14.4	0
Rice Krispies	45	129	0.3	31.4	3.8
Sugar Puffs	30	104	0.	25	16
CAKES AND PASTRIES					
Chocolate Cake	65	325	20	34.5	21.6
Cheesecake	50	210	17.4	12	5.9
Fruitcake	60	212	7.7	34.7	7.8
Madeira	25	98	4.2	14.6	4.9
Scones	50	158	4.9	26.5	1.2
BISCUITS					
Chocolate Digestives	30	147	7.2	19.9	7.5
Chocolate Coated	25 (1)	131	6.9	16.9	8.4
Digestive	30	141	1.9	20.6	4.6
Custard Cream	25	128	6.5	17.3	6.4
Semi-sweet Biscuits	15 (2)	69	2.5	11.2	2.8
Shortbread	35 (2)	174	9.1	22.4	4.2
Crisp Bread		77	0.5	16.9	0
Crackers	21	92	3.4	14.3	0
Oatcakes	26 (2)	115	4.8	16.4	0.8
BEVERAGES NON-ALCOHOLIC					
Cocoa Powder	3 (1tsp)	9	0.7	0.3	0
Drinking Chocolate	15 (3tsp)	55	0.9	11.6	10.4
Horlicks	20 (4tsp)	76	0.8	15.6	0.8
Ovaltine	15	54	0.4	11.9	0.6
CHEESE					
Brie	40	128	10.8	Tr.	0
Cheddar	40	165	13.8	0	0
Cottage	45	44	1.8	0.9	0
Cream Cheese	30	132	14.2	Tr.	0

Edam	40	133	10.2	Tr.	0
Edam (reduced fat)	40	92	4.4.	Tr.	0
Processed	20	66	5.4	0.2	0
CHEESE DISHES					
Cauliflower Cheese	310	326	21.4	15.8	0
Maccaroni Cheese	180	320	19.4	24.5	0
Pizza	160	375	18.9	39.7	0
Quiche	90	283??	20	15.6	0
CHOCOLATE					
Bounty	60 (2 small bars)	28.4	15.7	35	31
Chocolate Fancy and Filled	55 (1 bar)	253	10.3	40.3	36.1
Chocolate Milk	50 (1 bar)	265	15.2	29.7	28.2
Mars Bar	65 (1 bar)	287	12.3	43.2	42.7
CHUTNEY AND PICKLES					
Branston Pickle	35	47	0.1	12.0	10.3
CREAM					
Double	35	157	16.8	0.9	0
Single	35	69	6.7	1.4	0
EGGS					
Boiled	60	88	6.5	Tr.	0
Fried	60	107	8.3	Tr.	0
Scrambled	140 (2)	346	31.6	0.8	0
Egg and Bacon Pie	155	463	29.8	31.2	0
Omelette	135 (2)	258	22.1	Tr.	0
FATS ON BREAD/ROLLS					
Butter	8	59	6.5	0.1	0
Low Fat Spread	8	31	3.2	0	0
Margarine	8	59	6.5	0.1	0
Very Low Fat Spreads	8	22	2.0	0.3	0
FAT ON CRACKERS					
Butter	3	22		2.5	Tr.
Low Fat Spread	3	12	1.2	0	0

Food	Weight (g)	Energy (kcal)	Fat (g)	Carbohydrate (g)	Sucrose (g)
FISH (White, Cod, Haddock, plaice etc.)					
Battered	85 (1 piece)	169	8.	6.4	0
Grilled	130 (2 steaks)	124	1.7	0	0
Steamed	120 (2 fillets)	112	2.3	0	0
Salmon (steamed)	135	216	14.2	0	0
Oily Fish, (Mackrel, Herring etc.)					
Fried	110 (2 fillets)	207	12.4	0	0
Sardines	85	150	9.9	0.4	0
Prawns	80	86	1.4	0	0
Scampi	0	253	14.1	23.1	0
Tuna in oil	95	275	20.9	0	0
Tuna in brine	100	99	0.6	0	0
FISH DISHES AND PRODUCTS					
Fish Fingers	100 (4)	233	12.7	17.2	0
Fish Pie	265	339	15.1	34.5	0
FRUIT					
Apple	120	42	0	11	0
Banana	135	63	0.3	15.4	0
Grapefruit	140 (1/2 whole)	15	0	3.5	0
Orange	245	64	0	15.7	0
Peach	125	40	0	9.9	0
Pear	150	44	0	11.4	0
FRESH FRUIT JUICE					
Orange juice	200ml	66	0	17	0
FRUIT CANNED IN SYRUP					
Fruit salad	130	124	0	32.5	12.6
Peaches/ mandarins	110	96	0	25.2	14.7
Pineapples	150	116	0	30.3	14.8
Strawberries	85	69	0	17.9	14.9
FRUIT DRIED					
Figs	60 (4 figs)	128	7	31.7	0
Raisins	35	86	0	22.5	0
Prunes	40 (8 prunes)	43	0	10.6	2.4
MEAT					

Bacon	40	169	11.4	0	0
Beef (roast)	155	338	18.8	0	0
Chops (lamb and pork)	160	195	10.8	0	0
Lamb breast (roast)	85	349	31.5	0	0
Pork (roast)	85	243	16.8	0	0
Ham (boiled)	55	66	2.8	0	0
Corned Beef	60	130	7.3	0	0
Minced Beef	165	216	10.6	9.2	0
Sausages (grilled)	90 (2)	239	15.6	13.7	0
MILK					
Whole	600ml	396	23	28	0
Semi-skimmed	600ml	276	9.5	30	0
Skimmed	600ml	196	0.6	30	0
NUTS AND CRISPS					
Peanuts	30	171	7.3	14.7	0
Crisps	30	160	10.8	14.8	0
PASTA					
Spaghetti	150	156	1.1	33.3	0
POULTRY					
Chicken (roast, light meat)	85	121	3.4	0	0
Chicken leg	190	175	6.5	0	0
PUDDINGS					
Arctic Roll	30 (1 slice)	60	2.0	10.0	5.0
Non-dairy icecream	75	134	6.5	17.3	11.9
Jelly	135	82	0	20.4	19.1
Sponge Pudding	95	316	4.8	13.7	21
Diet Yoghurt	125	62	0.3	9.0	0
Low Fat Yoghurt	150	142	1.5	26	0
Fromage frais	100	83	0.4	13.9	10.0
PULSES					
Baked Beans	200	128	1.0	20.6	10.4
RICE					
Boiled White	165	233	1.8	53	0
Fried White	190	412	21.9	48.8	0
SAUCES					
White Sauce	80	120	8.2	8.7	0
Custard	75	88	3.4	12.5	3.3
Mayonnaise	20	138	15.1	0.3	0
Mayonnaise (reduced calorie)	20	58	5.6	1.6	0
SOUP					

Lentil	100	99	3.8	12.7	0
Vegetable	100	37	0.7	6.7	0
SWEET DRINKS					
Coca Cola	200ml	78	0	21	21
Lemonade	200ml	42	0	11.2	11.2
Lime Cordial	45ml	50	0	11.4	11.2
Orange Squash	45ml	48	0	12.8	10.1
SPREADS					
Honey	10	29	0	7.6	7.6
Jam	10	26	0	6.9	3.4
Lemon curd	10	29	1.4	4.1	3.9
Marmalade	10	26	0	7.0	5.7
SWEETS					
Boiled Sweets	100	327	0	87.3	86.9
Fruit Gums	30	52	0	13.4	12.7
Fruit Pastilles	40 (1 tube)	101	0	24.8	24.8
Liquorice Allsorts	100	313	2.2	74.1	67.2
Peppermints	30	118	0.2	30.7	24.9
Toffees	100	430	17.2	70.1	70.1
VEGETABLES					
Butter Beans	75	71	0.2	12.8	0
Kidney Beans	105	98	0.5	17.4	0
Potatoes (boiled)	120 (2 egg sized)	96	0.1	23.6	0
Potatoes (chips)	265	670	28.9	98.8	0
Potatoes (baked)	140	147	0.1	35	0
Potatoes (roast)	130	204	6.2	35.5	0
Peas (frozen, boiled)	85	31	0.3	0	0
Sweet corn	70	53	0.4	11.3	0
Carrots (boiled)	65	12	0	2.8	0
Broccoli (boiled)	95	0	0	1.5	0
Fried Mushrooms	55	116	12.3	0	0
Vegetable Curry	220	398	33.4	22	0
ALCOHOL					
Red Wine	114ml (1 glass)	78	0	0.3	0
Rose Wine	114ml (1 glass)	81	0	2.9	0
White Wine	114ml (glass)	74	0	0.7	0
Sherry (Dry)	47g	55	0	0.7	0
Liquers (Brandy, Whisky etc.)	24g	55	0	0.7	0
Beer	568ml (1pint)	176	0	13	13
Lager	568 (1 pint)	164	0	8.5	8.5

APPENDIX VIII.

COMPARISON OF RESULTS OF ANALYSIS USING THE FOOD SCORING SYSTEM WITH DATA ANALYSED USING COM-PEAT4.

Mean nutrient and energy consumption of subjects completing the programme, (weeks 1-8) estimated from 6 day food record diaries + s.e.m. (COM-PEAT4 vs food scoring system).

	LSD n=35		**SCD** n=33		*P*
	Mean	s.e.m.	Mean	s.e.m.	
Energy intake at baseline MJ (kcal/d)**C**	9.3 (2224)	± 0.47 (± 113.1)	9.0 (2169)	± 0.41 (± 99.5)	N/S
Energy intake at baseline MJ (kcal/d) **FSS**	9.2 (2221)	± 0.49 (± 117.5)	9.3 (2235)	± 0.40 (± 96.5)	N/S
P	N/S		N/S		
Energy intake week 8 MJ (kcal/d) **C**	5.7 (1376)	± 0.29 (± 69.9)	5.9 (1427)	± 0.28 (± 48.5)	N/S
Energy intake week 8 MJ (kcal/d) **FSS**	5.7 (1380)	± 0.28 (± 69.0)	5.7 (1377)	± 0.29 (± 69.9)	N/S
P					
Fat at baseline (g) **C**	90.1	± 5.2	86.3	± 5.1	N/S
Fat intake at baseline (g)	89.0	± 5.0	88.0	± 4.8	N/S
P	N/S		N/S		
Fat at week 8 (g) **C**	53..0	± 3.4	54.0	± 3.4	N/S
Fat at week 8 (g) **FSS**	52.2	± 4.1	48.8	± 2.9	N/S
P	N/S				
Fat intake at baseline (%E) **C**	36.3	±	36.0	± 1.40	N/S
Fat intake at baseline (% E) **FSS**	36.0	± 1.03	36.0	± 1.42	N/S
P	N/S		N/S		
Fat intake at week 8 (%E) **C**	34.6	± 1.3	32.8	± 0.9	N/S
Fat intake at week 8 (% E) **FSS**	35.0	± 1.16	32.0	± 1.15	N/S
P	N/S		N/S		
Carbohydrate at baseline (g) **C**	232.7	± 12.1	240.8	± 13.7	N/S
Carbohydrate intake at baseline (g) **FSS**	230.0	± 13.1	238.0	± 11.5	N/S
	N/S		N/S		
Carbohydrate week 8 (g) **C**	158.8	±	180.4	± 7.4	N/S
Carbohydrate week 8 (g) **FSS**	157.7	± 7.5	167.0	± 7.0	N/S
P	N/S				

	LSD n=35		SCD n=33		
	Mean	**s.e.m.**	**Mean**	**s.e.m**	
Carbohydrate at baseline (%E) **C**	39.5	± 1.1	41.4	± 1.2	N/S
Carbohydrate at baseline (% E) **FSS**	39.0	± 1.40	40.0	± 1.3	N/S
P	N/S		N/S		
Carbohydrate at week 8 (%E) **C**	43	± 2.0	46.0	± 1.22	N/S
Carbohydrate at week 8 (% E)****FSS**	44	± 1.6	46.0	± 1.2	N/S
P	N/S		N/S		

NB. Values at week 8 were the total mean from weeks 2, 4 and 8.

t-tests were used to assess the differences between the two groups.

* Percentage of total energy (including energy from alcohol) derived from fat..

** Carbohydrate values include added sucrose,

APPENDIX XI

QUEEN MARGARET COLLEGE

THE SENSORY APPRAISAL OF FOODS.

HEDONIC RATING SCALES.

This test requires you to assess your degree of liking for a drink. A 1 to 7 point scale ranging from extreme approval to disapproval is used. The overall impression and preference for the solution may be assessed in this way.

Taste each of the three coded samples. Decide how much you like or dislike each. Use the scale below to indicate your attitude by ticking the line which best describes your opinion of the sample. Please use a separate sheet for each different sample.

NAME:.....

DATE:.....

CODE NUMBER:.....

Your Opinion

Like very much.

Like moderately.

Like slightly.

Neither like nor dislike.

Dislike slightly.

Dislike moderately.

Dislike very much.

APPENDIX XI

REPRODUCIBILITY OF TASTE PREFERENCE TEST

The test for sweet preference was undertaken by the researcher on several occasions over the study, to ensure results could be replicated. The researcher was not aware of the sucrose concentration of each solution and indicated her preference in the same way as the subjects, using the 1-7 point scale.

Results.

WEEK	**1**			**2**		
Sample	**459**	**667**	**619**	**459**	**667**	**619**
Score	2	1	5	2	1	4

WEEK	**8**			**16**		
Sample	**459**	**667**	**619**	**459**	**667**	**619**
Score	2	1	4	2	1	5

Your Opinion

1. Like very much.
2. Like moderately.
3. Like slightly.
4. Neither like nor dislike.
5. Dislike slightly.
6. Dislike moderately.
7. Dislike very much.

Key

459 = 4%

667 = 6%

619 = 2%

APPENDIX X

QUESTIONNAIRE FOR OCCUPATIONAL HEALTH PERSONNEL AND MANAGERS

1. Could you please outline the perceived benefits of the study to your workforce?

2. Could you please outline any disadvantages of the weight reducing study?

3. Would you be happy for this type of programme to be run on a permanent basis on the firm's premises?

4. Do you feel that obese workers are at more risk of absenteeism though sickness than non-obese workers ?

5. Do you feel that enough attention is paid to health promotion and healthy eating within your company?

6. Do you feel that the individuals involved had more incentive to comply with the weight reduction programme because they participated with their work mates?

7. Do you have any other comments?

APPENDIX IX

DIETING QUESTIONNAIRE

Thank you for agreeing to help us with our research which is concerned with people's attitudes towards being on weight reducing diets and losing weight. This is part of a major research project examining dieting behaviour.

In this questionnaire you will find a series of questions about following weight reducing diets and losing weight. Most of the questions make use of a line scale. Please make a mark in the place which best describes your opinion. Please make only one mark for each question.

For example:
I intend to follow the weight reducing diet very carefully:

definitely----------definitely do.
do not.

If you make a mistake then put a cross over your original mark and make another one. When you have completed the questionnaire, please make sure that you have answered all the questions and then return it to the dietitian at your next appointment.

Thank you for your help.

GENERAL INFORMATION

Please indicate your answer by ticking the appropriate line.

1. What is your age?

18-29	30-39	40-49	50-59	60-69.

2. What is your gender?

male------- female-------

3. What weight are you?

-------stone -------lbs -------kilogrammes.

4. Have you ever in the past succeeded in losing weight?

-------yes -------no

If yes, what was the greatest ever amount of weight loss on any one of these occasions?

-------stone -------lbs --------kilogrammes

5. What do you consider your ideal body weight to be?

-------stones -------lbs --------kilogrammes.

6. Do you consider yourself to be overweight?

-------yes -------no

If yes at what age do you consider that you first became overweight?

-------years.

7. How much weight do you expect to lose by the end of the study (16 weeks)?

----------stones --------lbs ---------kilogrammes

8. How many people are there in your household?

-------1 ------2 -------3 ------4 --------5 -------6 --------7 or more.

SECTION A

1. I intend to follow the weight reducing diet very carefully:

definitely----------definitely do

do not

2. I intend to follow the weight reducing diet very carefully:

definitely----------definitely do

do not

3. I intend to eat fried fatty food less often:

definitely----------definitely do

do not

4. I intend to avoid the use of sugar on food and in drinks, whilst following my weight reducing diet::

definitely----------definitely do

do not

5. I intend to omit sweet foods from my weight reducing diet:

definitely----------definitely do

do not

6. I intend to avoid snacking in-between meals:

definitely----------definitely do
do not

SECTION B.

1. My attitude towards following the weight reducing diet very carefully is:

extremely----------extremely favourable.
unfavourable

2. My attitude towards losing weight is:

extremely----------extremely favourable.
unfavourable

3. My attitude towards eating fried/fatty foods less often is:
extremely----------extremely favourable
unfavourable

4. My attitudes towards avoiding sugar on food or in drinks, whilst following a weight reducing diet is:

extremely----------extremely favourable
unfavourable

5. My attitude towards omitting sweet foods from my weight reducing diet is:

extremely----------extremely favourable.
unfavourable

6. My attitude towards avoiding snacks in-between meals is:

extremely----------extremely favourable.
unfavourable

SECTION C.

1. Most people who are important to me think I should go on a weight reducing diet:

disagree----------agree.

2. Most people who are important to me think that I should lose weight:

disagree----------agree.

3. Most people who are important to me think I should be avoiding sugar on food and in drinks whilst following my weight reducing diet:

disagree----------agree.

4. Most people who are important to me think that I should be omitting sweet foods from weight reducing diet:

disagree----------agree.

5. Most people who are important to me think that I should be reducing fried/fatty foods in my diet:

disagree----------agree.

6. Most people who are important to me think I should avoid snacking in between meals:

disagree----------agree.

SECTION D

1. For me to follow a weight reducing diet very carefully will be:

difficult----------easy

2. For me to achieve weight loss will be:

difficult----------easy

3. For me controlling my intake of sugar on food and in drinks, whilst following a weight reducing diet will be:

difficult----------easy

4. For me controlling my intake of sweet foods whilst following a weight reducing diet will be:

difficult----------easy

5. For me controlling my intake of fried/fatty foods will be:

difficult----------easy

6. For me avoiding snacks in-between meals will be:

difficult----------easy.